REMEX

Peripheral Products

Ex-Cell-O Corporation

TECHNICAL MANUAL

FLEXIBLE DISK DRIVE

MODELS: RFD480
RFD960

IMPORTANT INFORMATION

Changes to the equipment which are made between manual printings are listed in an addendum at the rear of the manual. As a convenience, a list of change pages is given as the last page in the manual. It is recommended that each of these pages be marked "Refer to Addendum" so that these changes can be identified.

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FOR YOUR SAFETY

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The equipment described in this manual contains voltages hazardous to human life and safety and may contain mechanical components capable of inflicting personal injury. The cautionary and warning notes are included in this manual to alert operator and maintenance personnel to the electrical and mechanical hazards and thus prevent personal injury and damage to equipment.

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SECTION I

GENERAL DESCRIPTION

1.1 EQUIPMENT DESCRIPTION

The REMEX RFD480 and RFD960 diskette drives are small, direct access storage devices which utilize a removable flexible diskette as the storage medium. The standard slimline drive measures only 2.10 inches high by 5.75 inches wide thereby providing true slimline packaging. An optional bezel is available which measures 3.40 inches high. The drive consists of a spindle motor, two read/write heads and a split band stepping motor drive system for positioning the heads. The drive also uses light emitting diodes and phototransistors for index sensing, write control sensing and Track 00 detection, and two printed circuit boards to provide all required internal electronic functions. The RFD480 and RFD960 are similar units except for the density and capacity of each drive. The RFD480 has a recording density of 48 tracks per inch which provides up to 500 kbytes of unformated data per diskette while the RFD960 has a recording density of 96 tracks per inch, thereby providing up to 1.0 Mbytes of unformatted data per diskette.

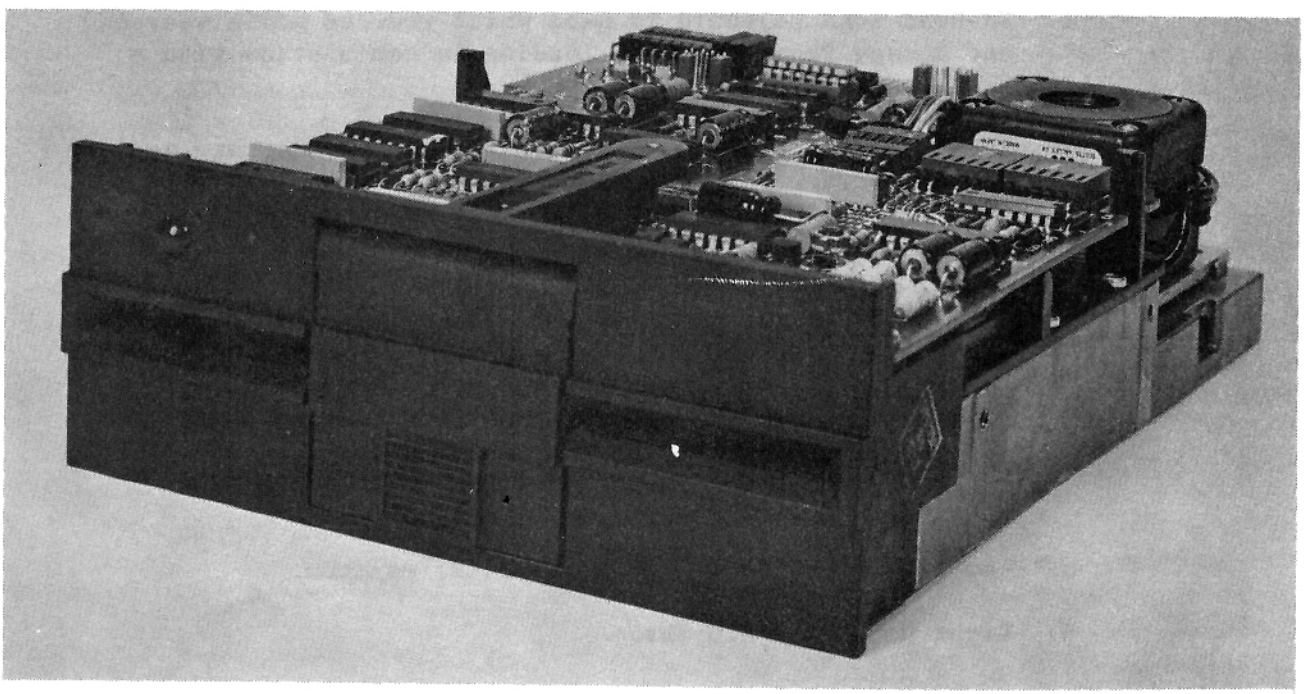

Figure 1-1. REMEX RFD960 Flexible Disk Drive.

Data is written on or read from the magnetic diskette surface by one of two read/write heads which are positioned to concentric tracks on the diskette surface by means of the stepper motor. The diskette spindle is driven at 300 RPM by a long life,direct drive,brushless DC motor.

The RFD480 and RFD960 are ANSI interface compatible as well as being compatible with many non - ANSI drives thru jumper options.

1.2 FEATURES

The following is a short summary of the features of the RFD480 and RFD960:

a. Storage capacity of up to four times that of single sided, single density flexible 5-1/4 inch drives.

b. Direct drive, brushless DC motor for longer life.

c. Closed loop, speed control servo gives motor speed regulation of 1%. Improved speed control stabilizes the data stream and reduces jitter.

d. Up to four drives may be daisy chained.

e. Single or double density capability.

f. 5 ms track - to - track access time.

g. Customer selectable jumper options for drive select.

h. An ANSI and industry compatible 5-1/4 inch drive.

i. No head load solenoid is used which reduces media wear and and damage from "tap,tap" loading in conjunction with a fast start/stop spindle motor.

j. Improved clutch and spindle design ensures accurate media - to - spindle registration.

k. Optical write control for reliable data security.

l. Band drive positioning for fast and reliable data access.

m. Electronic stepper motor damping shortens carriage settling time compared to mechanical damping techniques.

n. Overall height of 2.10 inches for true slimline and low profile packaging.

o. Low power consumption of 16.9 watts, maximum.

p. Light weight of 3.0 lbs.

1.3 EQUIPMENT WARRANTY

A statement covering the warranty of this equipment is given on page iii (second page in book). It should be read and understood. Any question arising concerning the warranty should be directed to the REMEX Service Department.

1.4 SPECIFICATIONS

Table 1-1 lists the specifications for the RFD960 and RFD480.

1.5 DISKETTE

The storage element used is a two - sided, removable, ferromagnetic coated flexible disk enclosed within a protective plastic jacket. See Figure 1-3 for an outline drawing of the diskette. The interior of the jacket is lined with a wiping material to clean the diskette of contamination. The diskette is always kept in a storage and traveling envelope to further protect the recording surface. Characteristics of the storage element are as follows:

Envelope Size:	5.25 x 5.25 ± 0.015 inch
Disk Diameter:	5.125 ± 0.003 inch
Track Width 96 TPI:	.00625 inches
Track Width 48 TPI:	.01300 inches
Track Spacing 96 TPI:	.01042 inches
Track Spacing 48 TPI:	.02083 inches

1.6 RELIABILITY

This section defines the long term unit reliability and data integrity of the diskette drive.

1.6.1 DESIGN LIFE

The drive is designed and constructed to provide a MTBF of 10,000 power on hours and a design life of 5 years. During the design life, repair or replacement of parts is permitted by the factory.

1.6.2 RECOVERABLE READ ERROR

The recoverable read error rate is less than one error in 10^9 bits.

1.6.3 NONRECOVERABLE READ ERROR RATE

The nonrecoverable read error rate is less than one error in 10^{12} bits read. A read error is defined in Section 3. Errors attributed to the diskette are not included in determining the nonrecoverable read error rate.

Table 1-1. Specifications, RFD960 and RFD480.

Specification, Units - Dual Head SD = Single Density DD = Double Density		RFD480		RFD960	
		SD	DD	SD	DD
Unformatted Bytes Per Disk		250K	500K	500K	1.0M
IBM Format (16 Sectors/Track), Bytes Per Disk		163,840	327,680	327,680	655,360
Recording Density, BPI		2938	5876	2961	5922
Track Density, TPI		48	48	96	96
Number of Tracks Per Diskette		80	80	160	160
Transfer Rate, Bits/Sec.		125K	250K	125K	250K
Recording Method		FM	MFM/M^2FM	FM	MFM/M^2FM
Temperature:	Operating:	$10^{\circ}C$ to $50^{\circ}C$ ($40^{\circ}F$ to $122^{\circ}F$)			
	Storage:	$-34^{\circ}C$ to $65^{\circ}C$ ($-30^{\circ}F$ to $149^{\circ}F$)			
	Max. Wet Bulb:	$29^{\circ}C$ ($85^{\circ}F$)			
Humidity:	Operating:	20% to 80%			
	Storage:	5% to 98% (No Condensation)			
Rotational Speed		300 rpm ± 1%			
Latency (average)		100 ms			
Track to Track:		5 ms max.			
Access Time (average including settling)		RFD480: 80 ms		RFD960: 147 ms	
Settling		15 ms max.			
Motor Start Time		200 ms max.			
Weight		3.0 lbs (1.4 Kg)			
D.C. Power Requirements		Average Operating: + 12 VDC ± 5%, 1.25 A, max. + 5 VDC ± 5%, 0.41 A, max. Current Surge: + 12 VDC, 1.65 A, max. + 5 VDC, 0.57 A, max.			
Power Dissipation		16.9 Watts (57.7 BTU/Hr) max.			
Dimensions See Installation Drawing, Figure 1-2		Height: 53.5 mm (2.11 in) Width: 146 mm (5.75 in) Depth: 203 mm (8.00 in)			

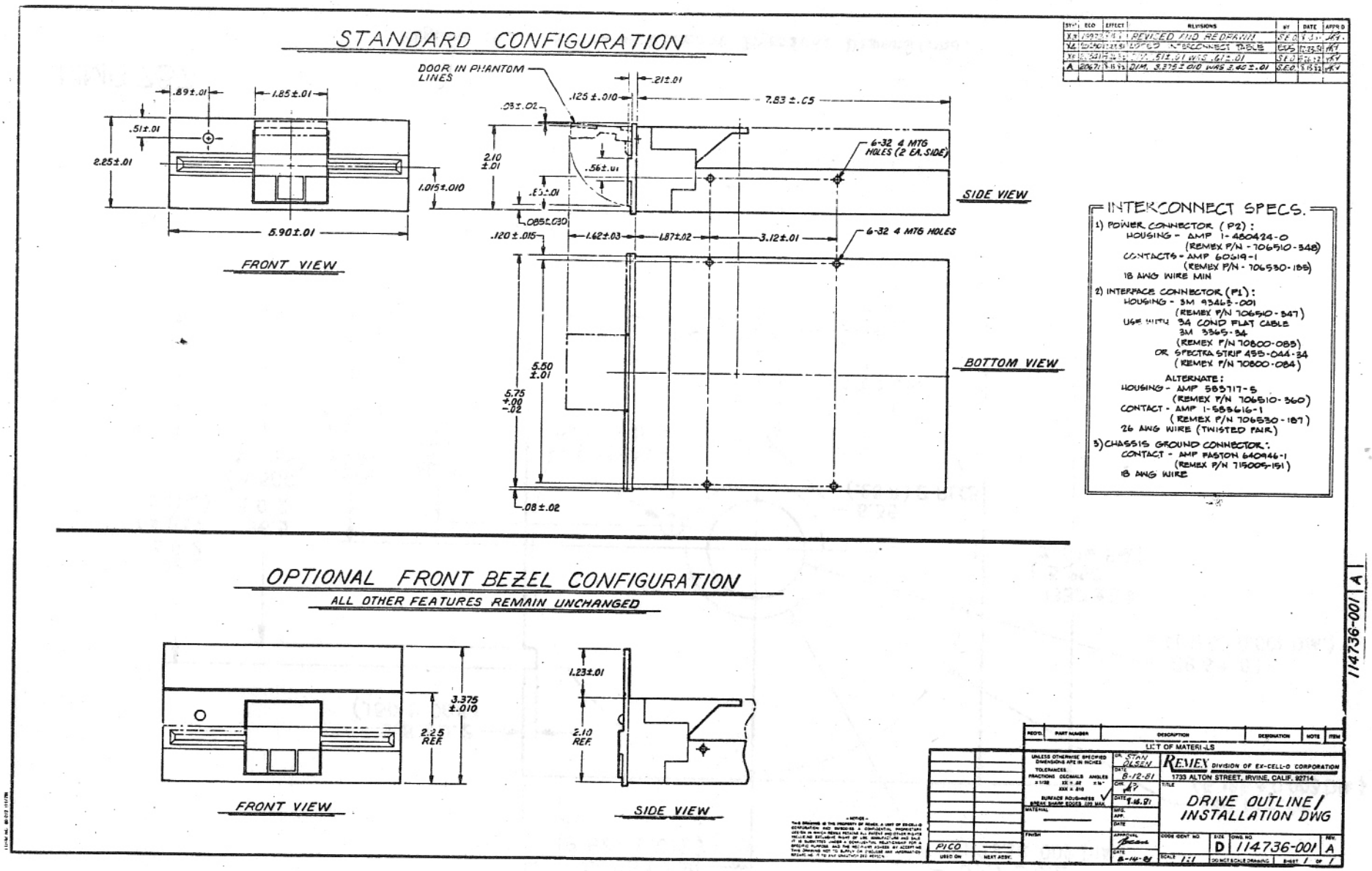

Figure 1-2. Installation Drawing.

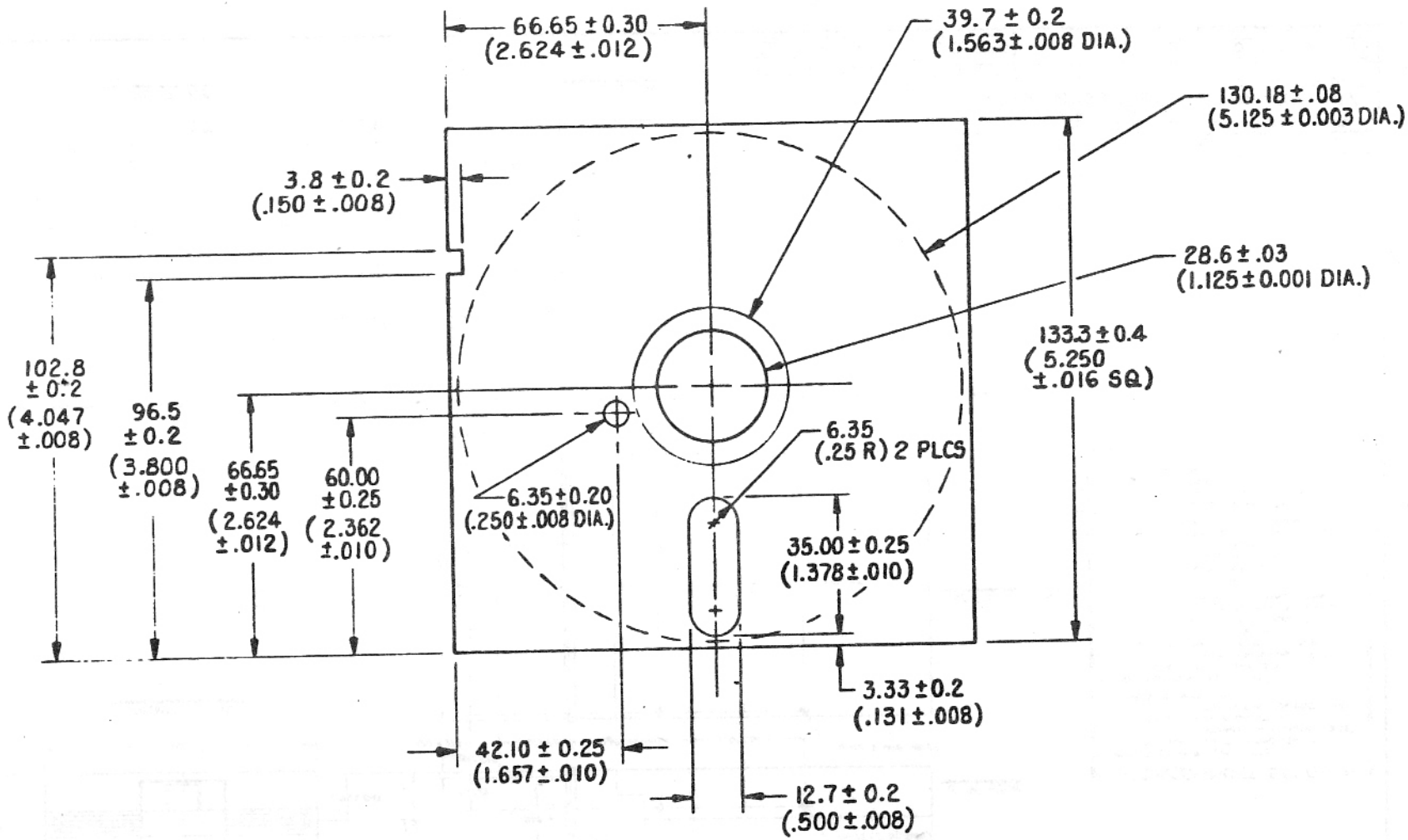

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Figure 1-3. Storage Element Physical Dimensions.

1.6.4 ACCESS POSITIONING ERROR RATE

The access mechanism positioning error rate is less than one error per 10^6 seek executions.

1.6.5 MEAN TIME TO REPAIR (MTTR)

The mean time to repair is 30 minutes when performed by a thoroughly trained technician.

1.7 RECORDING FORMAT

The format of the data recorded on the diskette is totally a function of the host system and can be designed to the user's application to take best advantage of the total available bit capacity of any one track or diskette. While many formats currently exist, the format described in Figure 1-4 was compiled from the ECMA standard TC19/80/7 as is presented as a representative sample.

	DESCRIPTION	TRACK 00 SIDE 0 SINGLE DENSITY		ALL OTHER TRACKS MFM	
		BYTES	HEX	BYTES	HEX
	INDEX GAP	16	FF	32	4E
EACH SECTOR • REPEAT 15 TIMES	SECTOR IDENTIFIER				
	IDENTIFIER MARK	6	00	12	00
		1	FE*	3	A1*
				1	FE
	CYLINDER ADDRESS	1	00	1	(1)
	SIDE NUMBER	1	00	1	00 or 01
	SECTOR NUMBER	1	01-10	1	01-10
	4^{th} BYTE	1	00	1	01
	EDC	2	XX	2	XX
	IDENTIFIER GAP	11	FF	22	4E
	DATA BLOCK				
	DATA MARK	6	00	12	00
		1	FB*	3	A1*
				1	FB*
	DATA FIELD	128	(1)	256	(1)
	EDC	2	XX	2	XX
	DATA BLOCK GAP	24	FF	48	4E
	TRACK GAP (AFTER 16^{th} SECTOR DATA BLOCK GAP ONLY)	(2)	FF	(2)	4E

FE* = 11111110 with missing clock transitions of B_6, B_5 and B_4.

FB* = 11111011 with missing clock transitions of B_6, B_5, and B_4.

A1* = 10100001 with missing boundary transition between B_3 and B_4.

(1) = Required data or number.

XX = Error Detection Code (EDC) = $X^{16} + X^{12} + X^5 + 1$.

(2) = Writing of Track Gap takes place until Index Hole is detected.

Figure 1-4. ECMA Proposed Format For 5-1/4 inch Diskettes.

SECTION II

INSTALLATION AND INTERFACE

2.1 UNPACKING

To provide the most protection during transit, specially designed and reinforced packing cartons are used to ship the REMEX diskette drive. When removing the drive from the carton, lift the unit with both hands under it. Never lift or attempt to carry the drive by any of its components, drive door or other delicate parts. Carefully inspect the drive for any apparent damage as soon as it is removed from the carton. In the event the drive has been damaged as a result of shipping, the carrier and REMEX must be notified as soon as possible.

CAUTION

To prevent magnetization of the heads, it is important that during unpacking, installation and operation, that the read/write heads do not come in contact with stray magnetic fields.

Each drive is shipped with a dummy diskette inserted in the drive. This diskette should be removed after the drive is installed in the system.

2.2 MOUNTING

The unit may be installed and operated in either of two positions, i.e., horizontal front load or vertical front load. It should be placed in an environment so that the unit does not exceed the ambient temperature specifications listed in Table 1-1.

2.3 INITIAL ADJUSTMENTS AND OPTIONS

Each diskette drive has been accurately adjusted and aligned before leaving the factory. No adjustment or calibration should be required prior to installation or use. Five optional procedures (Sections 2.3.1 thru 2.3.5) are available to the customer as described below and must be performed as required before operating the drive. Refer to Figure 7-4 for location of the various items referred to in Sections 2.3.1 thru 2.3.5.

2.3.1 LINE TERMINATOR

At location 12B on the Control Card, there is a removable resistor pack (220 Ω/330 Ω) installed as shipped from the factory. This resistor pack is for input line termination. If the drives are used in a daisy chain application, this resistor pack should be removed from all drives except the last drive on the daisy chain.

2.3.2 DRIVE SELECT JUMPERS

Four sets of pins (DS0-DS3) have been provided to select which Drive Select line will activate the interface signals for a unique drive. Each drive is shipped with a jumper installed at DS0 for selecting drive number 0. To change to another drive select number, remove the jumper and reinstall it as directed in Table 2-1.

Table 2-1. Drive Select Jumper Installations.

JUMPER	FUNCTION
DS0	Drive selected by Drive Select 0* input
DS1	Drive selected by Drive Select 1* input
DS2	Drive selected by Drive Select 2* input
DS3	Drive selected by Drive Select 3* input provided RDY is not jumpered (See Section 2.3.3).

2.3.3 READY SIGNAL OPTION

On drives using Drive Control Card 114761-001, a 0V static output can be provided on J1-6 as a Ready signal for those controllers that require this indication. This is accomplished by jumpering the RDY pins located below the DS0 - DS3 pins. When using this option, only three drives (DS0 - DS2) can be selected. On drives with the Drive Control Card 114861-001, a dynamic 'L' Ready signal is available at J1-34 and at J1-6 (provided RDY is jumpered as previously described for the static output). This signal indicates the drive is selected, DC power is applied and index pulse repetition rate is 200-300 ms (the spindle motor is rotating at 200-300 rpm or faster).

CAUTION

Either pin J1-6 or J1-34 should be used singularly as the Ready line. If J1-6 is used, J1-34 must not be terminated. If J1-34 is used, the RDY pins must not be jumpered.

2.3.4 MOTOR CONTROL OPTIONS

Jumpers A - D located on the Drive Control Card are used to operate the spindle and stepper motors as described in Table 2-2. Only one of the four combinations can be selected for any drive.

Table 2-2. Spindle and Stepper Motor Operation Options.

JUMPER	FUNCTION
A and D	Motor On* command turns on the spindle motor and any valid Drive Select energizes the stepper motor.
A and C	Motor On* command alone simultaneously turns on the spindle motor and energizes the stepper motor.
B and C	Any valid Drive Select* command alone simultaneously turns on the spindle motor and energizes the stepper motor.
A	Motor On* command only turns on the spindle motor. The stepper motor is always energized with the application of DC power to the drive.
B	Any valid Drive Select* Command alone simultaniously turns on the spindle motor. The stepper motor is always energized with the application of DC power to the drive.

2.3.5 WRITE PROTECT DEFEAT

In normal operation, write current through the R/W head is inhibited internally in the drive when a write protected diskette is installed. This can be defeated by cutting the trace coming from Z3C, pin 11 on the Drive Control Card.

2.4 SIGNAL CONVENTIONS

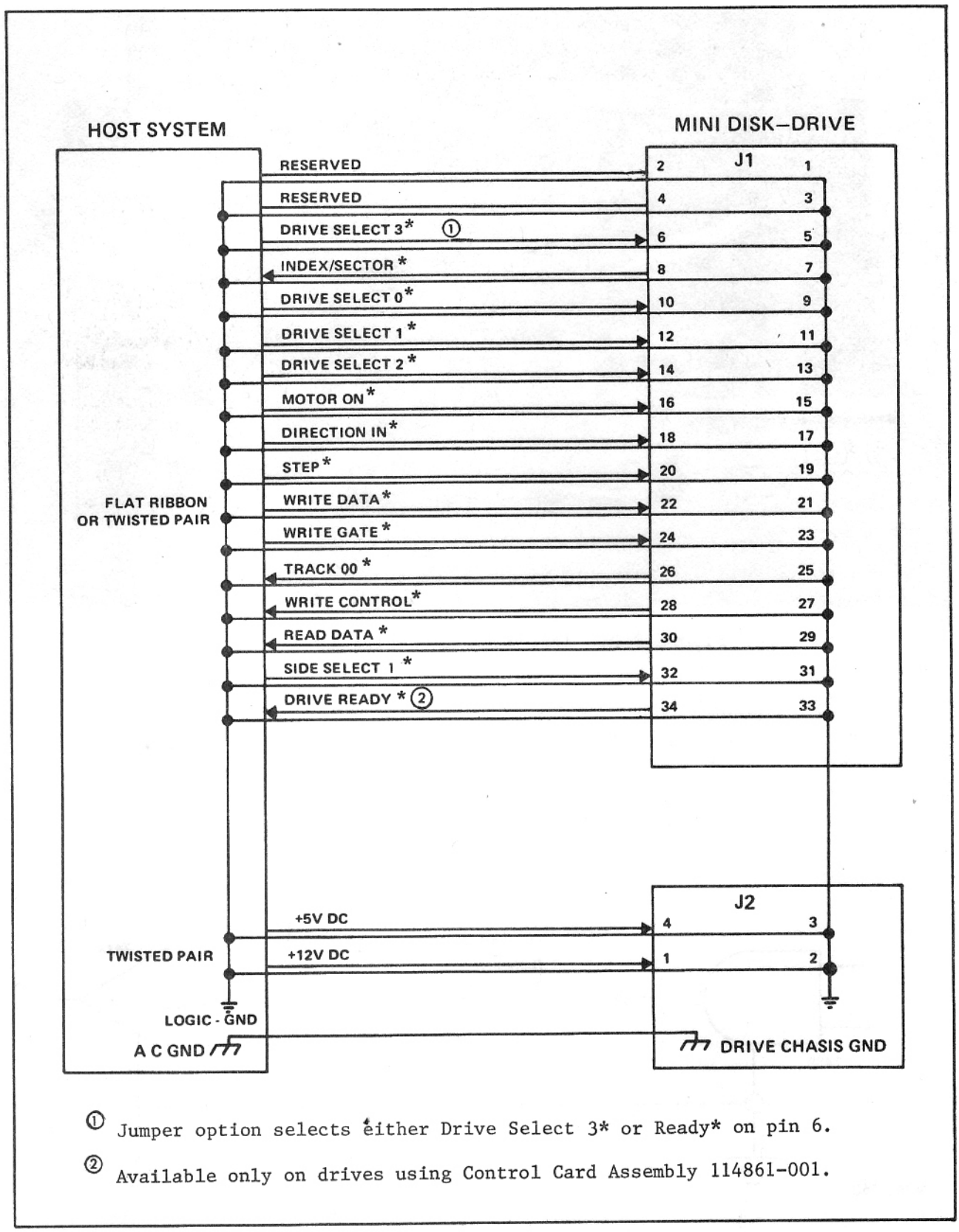
The following conventions are used throughout the manual to define the various signal mnemonics:

a. 'H' represents a high voltage (+ 2.5V $\leq$ 'H' $\leq$ + 5.25V).

b. 'L' represents a low voltage (0V $\leq$ 'L' $\leq$ + 0.4V).

c. Rising edge represents a transition from 'L' to 'H'.

d. Falling edge represents a transition from 'H' to 'L'.



① Jumper option selects either Drive Select 3* or Ready* on pin 6.

② Available only on drives using Control Card Assembly 114861-001.

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Figure 2-1. Interface Signal Connections.

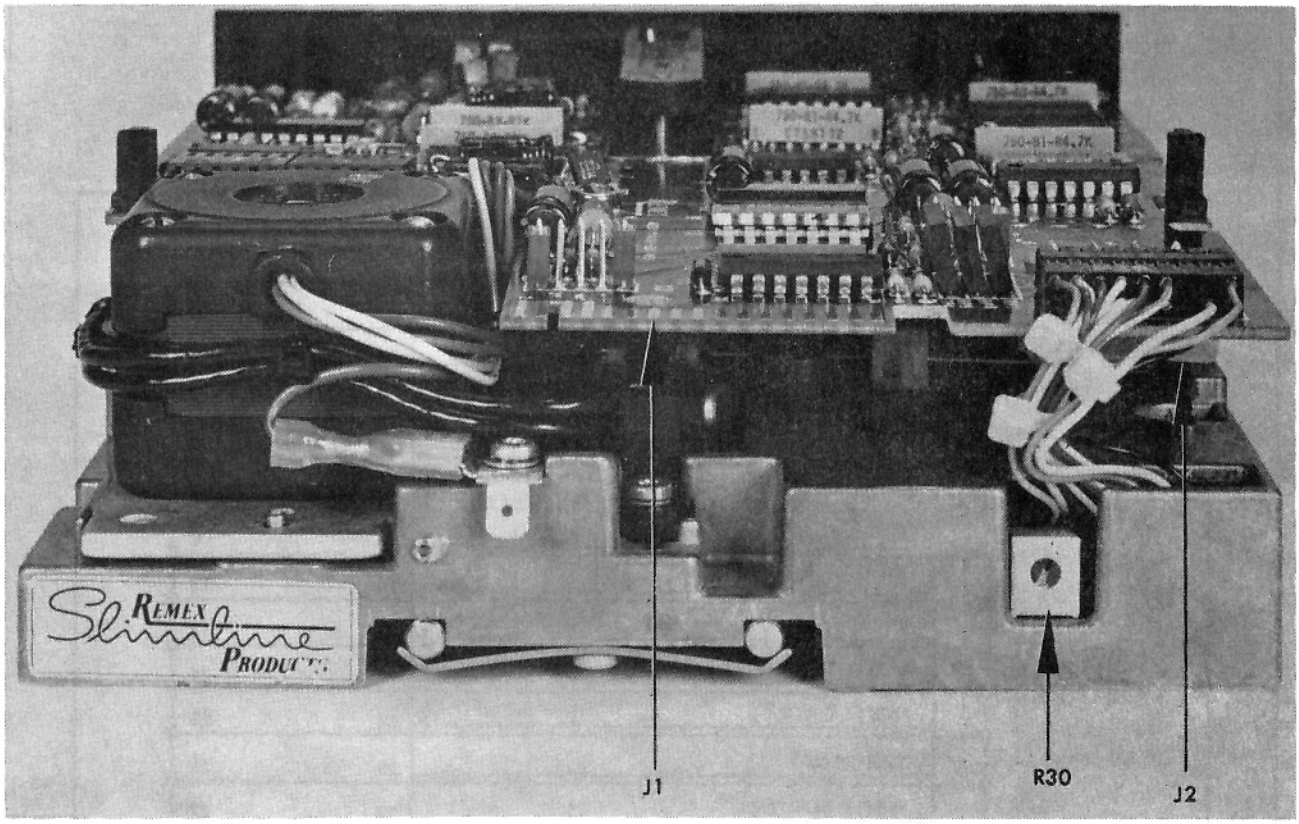

Figure 2-2. Interface Connector Locations

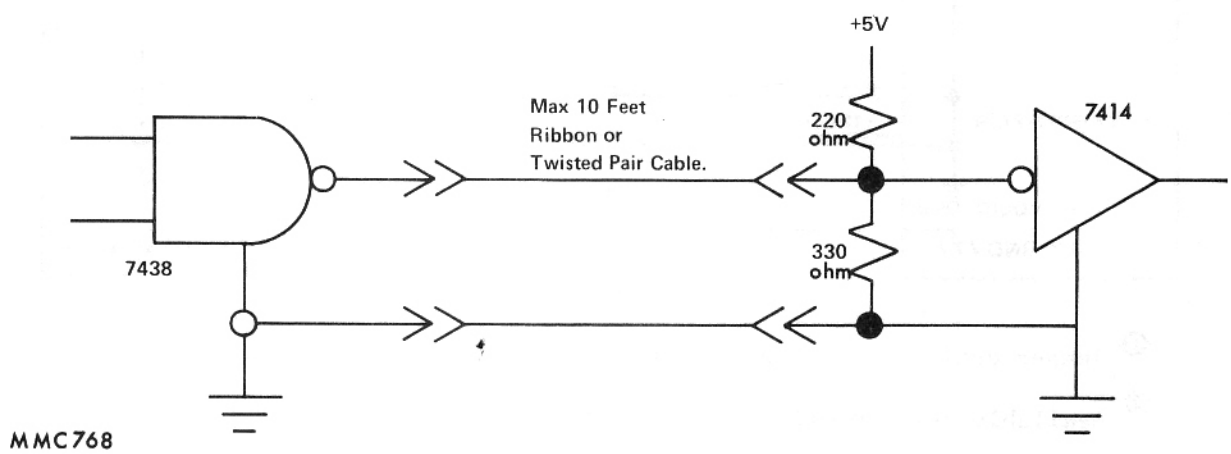

Figure 2-3. Recommended Interface Circuits.

SECTION III

OPERATION

3.1 I/O INPUT - OUTPUT SIGNALS

Section 2.5 and Table 3-1 describe the input/output signals routed through J1. Section 3.3 describes the various operations and timing required when operating the diskette drive. DC power is described in Section 2.5. No AC input is required. Signal level definitions are given in Section 2.4.

3.2 OPERATOR CONTROLS

The diskette drive is under full, automatic direction of a computer controller except for loading and unloading the diskette. A front panel indicator light indicates that the drive is selected. The only operator control is the front door mechanism which provides access to insert and remove diskettes. Section 3.3.3 describes the loading and unloading of a diskette.

3.3 LOADING AND OPERATING INSTRUCTIONS

The REMEX diskette drives are designed for ease of operator use. There are no complicated controls and indicators. The following sections outline the procedures for loading and operating the drive. Also included are some suggested software procedures for handling error conditions which might occur during writing or reading operations.

3.3.1 POWER UP MODE

Applying DC power and a Motor On* Command to the RFD960 and RFD480 requires that a 200 ms delay be introduced before any Read or Write operation is attempted. This delay is for stabilization of the diskette rotational speed. After powering on, the initial position of the R/W heads with respect to the data tracks is indeterminable when using an unformatted diskette. In order to assure proper positioning of the R/W heads prior to any read/write operation after powering on, a series of step out operations should be performed until the Track 00* signal is active. If the diskette is formatted, a read operation will identify the track position of the heads.

3.3.2 DISKETTE HANDLING

The diskette consists of the flexible disk encased in a plastic jacket. When not in use the diskette is always stored in a protective envelope.

An analogy of this protective storage envelope would be the same as the envelope used to store phonograph records used in your home. The storage envelope affords the same protection from dust and contaminants.

To protect the diskette, the same care and handling procedures specified for computer magnetic tape apply. These precautionary procedures are as follows:

a. Return the diskette to its storage envelope whenever it is removed from file.

b. Store diskettes vertically.

c. Keep diskettes away from magnetic fields and from ferromagnetic materials which might cause magnetization. Strong magnetic fields can destroy recorded data on the disk.

d. Replace storage envelopes when they become worn, cracked or distorted. Envelopes are designed to protect the diskette.

e. Do not write on the diskette with a lead pencil or ballpoint pen. Use a felt tip pen.

f. Do not smoke while handling the diskette. Heat and contamination from a carelessly dropped ash can damage the disk.

g. Do not expose diskettes to heat or sunlight. The read/write head cannot properly track a warped disk.

h. Do not touch or attempt to clean the disk surface. Abrasions or foreign material from the hands may cause loss of stored data.

Table 3-1. Interface Connection Descriptions for J1.

Connector Pin (1)	Description (2)
J1-1, 2; 3, 4	Reserved
J1-5, 6; 9, 10; 11, 12; 13, 14	Drive Select 3*, 0*, 1*, and 2* inputs, respectively. An 'L' signal is used to select one of four drives depending upon the line activated. To properly select a drive, the jumper for that drive must be installed as described in Section 2.3.2. Under normal operation, the Drive Select line will: (1) apply power to the stepper motor, (2) enable the input lines, (3) activate the output lines and (4) light the Activity LED. Power to the stepper motor can be optionally controlled as described in Section 2.3.4. Deactivation of the Drive Select* input must be delayed 875 µs, min., following a Write operation to ensure that the track is fully tunnel erased. J1-6 can also be used as a static ground RDY output or a dynamic RDY output as described in Section 2.3.3.
J1-7, 8	Index/Sector* output. This 'L' signal is provided by the drive once each revolution of the diskette. The falling edge of the 'L signal indicates the beginning of the track. To correctly detect Index* at the Host System, the Index* line is in the 'H' state until activated by the Drive Select*. The first falling edge, thereafter, indicates the first detection of Index*. When writing, the host should wait for the falling edge of the second Index* pulse.
J1-15, 16	Motor On* input. An 'L' signal activates the spindle motor. The 'H' signal prevents the spindle motor from running even when D.C. power is applied. Enabling the spindle motor can be can be optionally controlled as described in Section 2.3.4.
J1-17, 18	Direction In* input. This line defines the direction the read/write heads will move when the step line is pulsed. An 'L' signal will move the read/write heads in toward the center of the diskette on the rising edge of the Step* signal. An 'H' signal will move the read/write heads out away from the center of the diskette on the rising edge of the step signal.
J1-19, 20	Step* input. This line causes the read/write heads to move in the direction selected by J1-18, Direction In* line. The movement is initiated on the rising edge of the pulse. Any change in the Direction In* line must be made at least 1 µs before the rising edge of the Step* pulse. If the movement is in the same direction, the minimum time between Step* pulses is 5 ms. If the Direction In* line is changed between Step* pulses, a 20 ms, min. delay is required between the rising edge of the Step* pulses. The minimum width of this pulse is 1 µs.
J1-21, 22	Write Data* input. Data to be written on the diskette is transferred on this line. An 'L' level Write Gate* input at J1-23 will enable this line. Each transition from an 'H' level to 'L' level on this line will cause the current through the selected read/write head to be reversed.
J1-23, 24	Write Gate* input. An 'L' signal enables the Write Data* input line, allowing data to be written. An 'H" signal enables the read logic.
J1-25, 26	Track 00* output. An 'L' signal indicates that the read/write heads are located at track 00 and the stepper motor phases A and B are on. An 'H' signal indicates that the read/write head is not located at track 00.
J1-27, 28	Write Control* output. An 'L' signal indicates that the loaded diskette contains a covered ANSI Write protect notch, indicating that the diskette is write protected. An 'H' signal indicates that a diskette with an uncovered write protect notch has been inserted and writing may occur. This signal inhibits writing in the drive logic when the 'L' signal is present. The Write Protect feature can be defeated as described in Section 2.3.5.
J1-29, 30	Read Data* output. This line provides the composite clock and data signals as read directly from the diskette. An 'L' signal indicates a data or clock bit is present and an 'H' signal indicates the absence of data. The falling edge of the signal should be used for decoding the data stream.
J1-31, 32	Side Select 1* input. This line defines which side of the two sided diskette is to be used for reading or writing. An 'H' signal selects the read/write head on side 0. An 'L' signal selects side 1. When switching from one head to the other, a 4 µs delay is required before any read or write operation commences. Changing the Side Select 1* input must be delayed at least 935 µs following a write operation to ensure that the track is fully tunnel erased.
J1-33, 34	Ready* output. An 'L' signal indicates that the drive is selected, D.C. power is applied

(1) All odd pins on J1 are used as return lines.

(2) All signals on J1 are defined for negative TTL logic as described in Section 2.4. The mating connector for J1 is described in Section 2.5.

3.3.3 DISKETTE LOADING/UNLOADING

The following procedure should be followed when loading or unloading a diskette:

a. Open the drive door by depressing the latch.

b. Apply DC power to the drive.

c. Select the drive to be used by using the appropriate Drive Select* signal. See Table 3-1.

d. Activate the appropriate command to energize the drive motor. Refer to the jumper option description, Section 2.3.4 and Table 2-2.

e. Carefully remove the diskette to be inserted from its storage envelope.

NOTE

When using a diskette containing the write protect notch, make sure the notch is covered if it is desired to protect the diskette data from accidental erasure and write-over. This will activate the Write Control output signal at J1-28. The host software should then process this signal and inhibit writing. However, the drive will inhibit write and erase current internally unless defeated by the trace cut described in Section 2.3.5. If writing is desired the notch must be uncovered.

f. Insert the diskette into the drive with the label to the outside and facing up. See Figure 3-1. Exert inward pressure on the diskette until it stops. Close the door by pressing the latch shut.

g. The drive may now be operated in any of the modes of operation described in Sections 3.3.4 thru 3.3.8.

h. To unload the diskette, depress the door latch momentarly. The door will open and the diskette will eject approximately one inch for easy removal. Remove the diskette and return it to its protective envelope. Close the drive door.

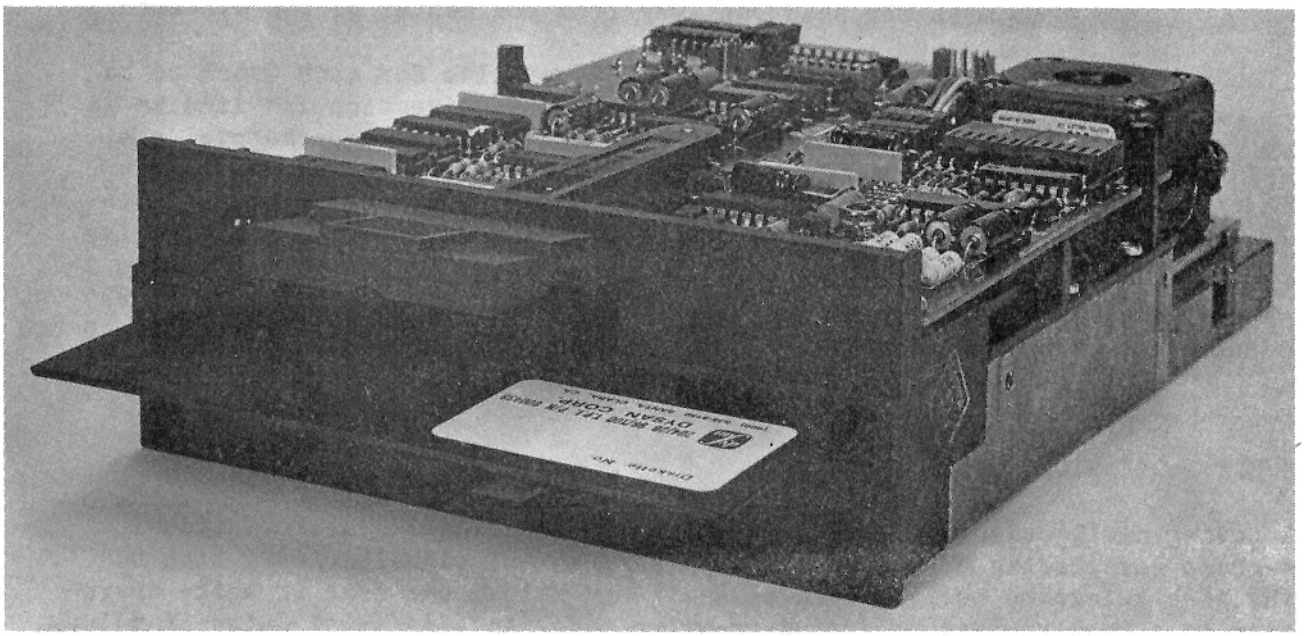

Figure 3-1. Diskette Insertion.

3.3.4 DRIVE SELECTION

Applying an 'L' signal to one of the four Drive Select* lines will enable the selected drive only. The position of the Drive Select jumper is used to select the number of the drive as described in Section 2.3.2. Only one line can be active at a time. The functions of the Drive Select line are the following:
(1) enable the input lines,
(2) activate the output lines and
(3) illuminate the acivity LED.
The stepper motor can be powered on using the jumpering option described in Section 2.3.4 item (2). Drive select timing is shown in Figure 3-2. Generally the Motor On* line is also activated before or when the drive is selected (depending on the option selected) so that a diskette can be inserted.

3.3.5 TRACK POSITIONING

The following sequence should be used when stepping from one track to another. Figure 3-2 shows the track access timing. If power has just been applied, the position of the read/write heads may not be known. If this is the case, the head should be stepped out until the Track 00* signal is in the 'L' state.

a. Select the drive and apply power to the drive motor. See Sections 3.3.4 and 2.3.4.

b. Place the Direction In* input in the 'L' state to move the head towards the center of the diskette or in the 'H' state to move the head out away from the center of the diskette.

c. Apply a Step* pulse to the Step* line for each track to be stepped. It is important that the Direction In* line be in the desired state and be stable at least 1 µs before the rising edge of the Step* pulse appears. If the Direction In* line is changed between Step* pulses, a 20 ms min. delay is required between the rising edge of the Step* pulses. The minimum width of the step signal is 1 µs. See Figure 3-2. When going from a write to a step operation, a delay of 935 µs, min. is required from the change in the Write Gate* line to the rising edge of the Step* pulse.

3.3.6 SIDE SELECTION

Applying an 'L' signal to the Side Select 1* line (J1-32) selects side 1 surface for reading or writing and applying an 'H' signal selects side 0. The side selection must be made 4 µs minimum before the read or write operation in a read-to-read or a read-to-write mode. An additional delay of 935 µs, minimum, is required when going from a write to a read or write operation to ensure that the written track is fully tunnel erased.

3.3.7 READ OPERATION

Figure 3-3 illustrates the read timing sequence. The following sequence should be followed:

a. Place the desired Drive Select* and Motor On* lines in the active state. See Section 3.3.4.

b. Make sure the Write Gate* input is in the 'H' state.

c. Step the head to the desired track. See Section 3.3.5.

d. Select the desired side. See Section 3.3.6.

e. Valid read data will appear 200 ms after the Motor On* signal shown in Figure 3-3. When going from a write to a read operation, a delay of 935 µs, min., is required from the change in the Write Gate* line to the first valid Read Data*. The read data is composite, i.e., composed of clock and data bits. For the MFM and M^2FM codes, a phase lock oscillator (PLO) circuit is required to replace missing clock bits to the decoder.

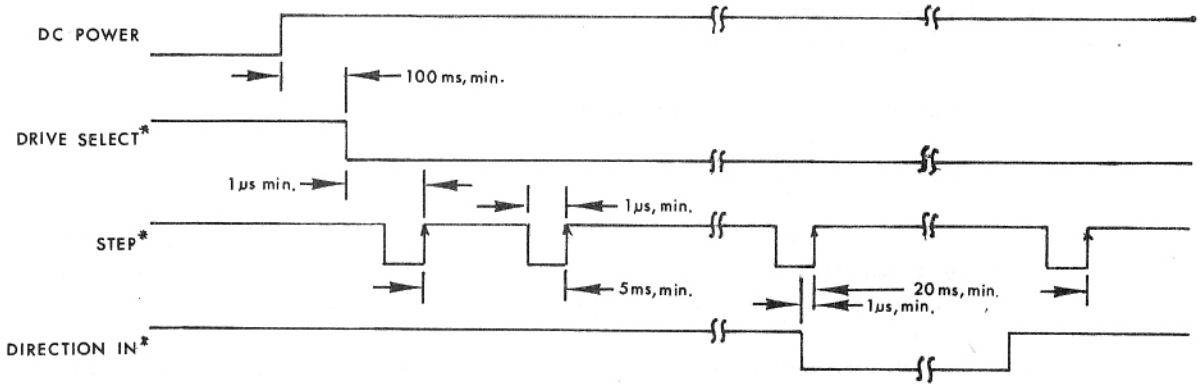

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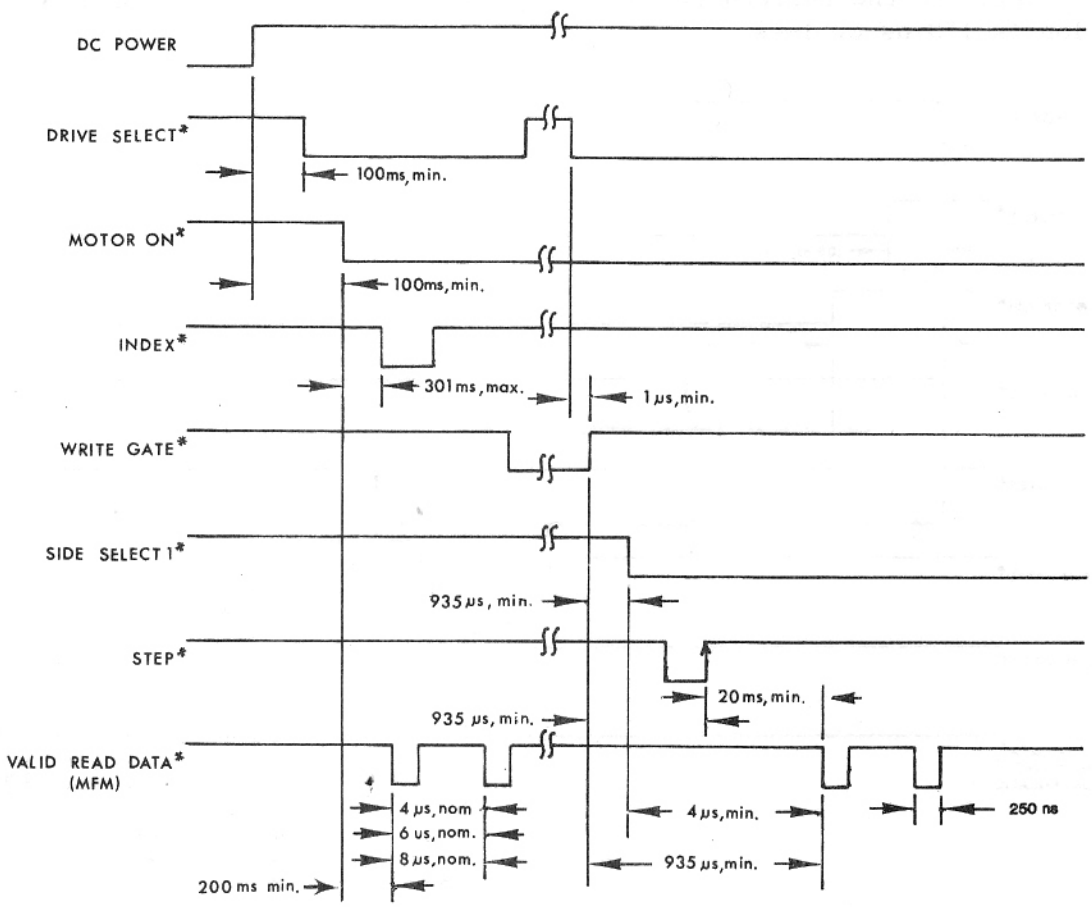
Figure 3-2. Track Access Timing.



MMC 764

Figure 3-3. Read Initiate Timing (MFM Encoding).

3.3.8 WRITE OPERATION

Figure 3-4 illustrates the Write timing sequence. The following sequence should be followed:

a. Place the desired Drive Select* and Motor On* lines in the active state. See Section 3.3.4.

b. Step the head to the desired track. See Section 3.3.5.

c. Select the desired side. See Section 3.3.6.

d. Place the Write Gate in the 'L' state. A 1 µs min. delay is required after the desired side is selected before data can be written. See Figure 3-4.

e. Apply the data to be written on the Write Data Input line after the required delays shown in Figure 3-4 have occurred. See Figure 3-5 for Write Data Timing using FM encoding.

Write data encoding can be FM, MFM or M^2FM. If MFM or M^2FM is used, the write data can be precompensated to minimize the effects of bit shift. The amount and direction of compensation required for any given bit in the data stream depends on the pattern it forms with nearby bits. Recommended precompensation is 150 ns or less.

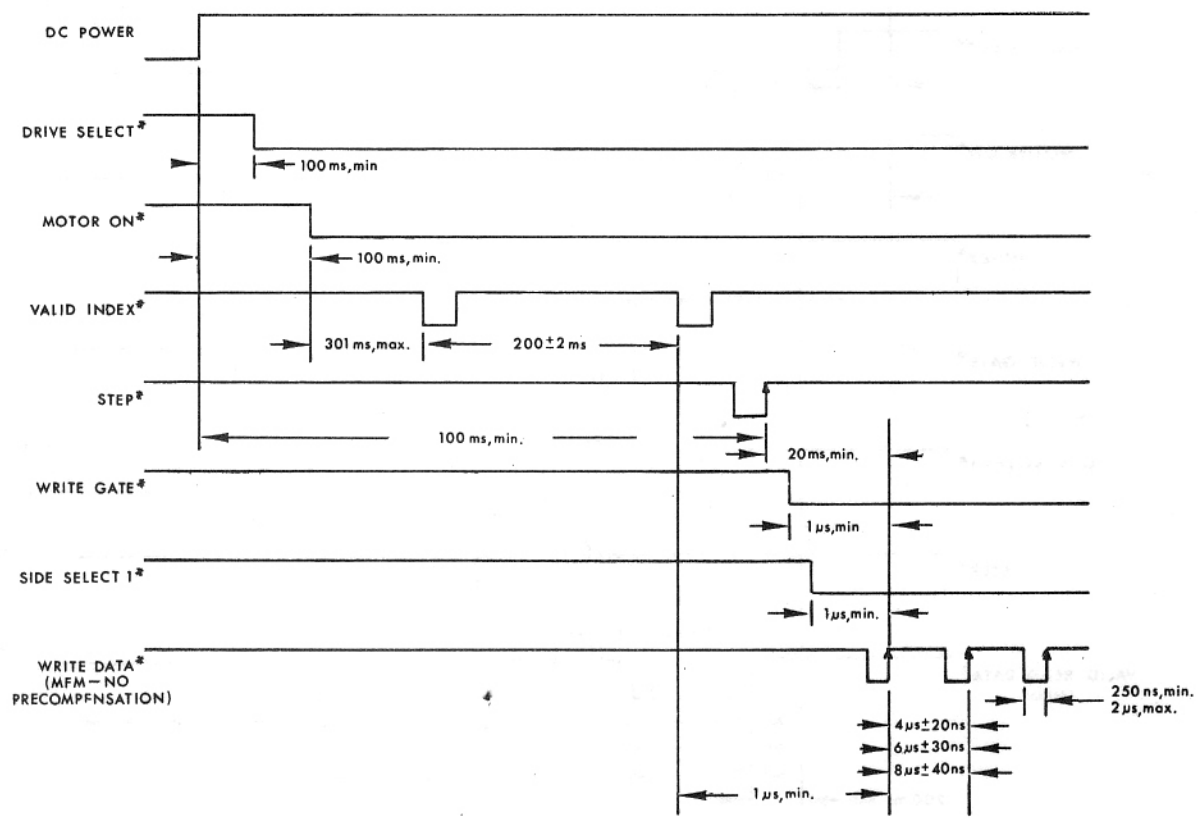


Figure 3-4. Write Sequence Timing.

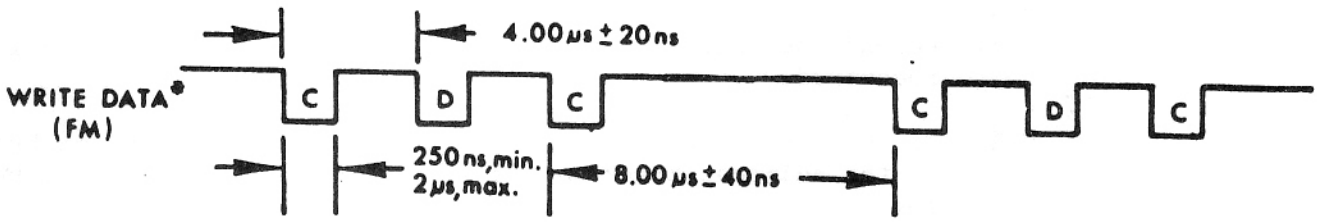


Figure 3-5. Write Data Timing (FM Encoding).

3.3.9 ERROR DETECTION AND CORRECTION

3.3.9.1 Write Error

If an error occurs during a write operation and is detected on the next revolution by doing a read operation, commonly called a "write check", the error can be corrected by doing another write and write check operation. If the write operation is not successful after 4 attempts have been made, that sector or track should be labeled defective and error correction should be attempted on another track. If the error still persists, the diskette should be considered defective and discarded.

3.3.9.2 Read Error

Most errors that occur will be "soft" errors, that is, by performing an error recovery procedure the data will be recovered.

Soft errors are usually caused by:

a. Airborne contaminants that pass between the read/write head and the disk. These contaminants will generally be removed by the cartridge self - cleaning wiper.

b. Random electrical noise which usually lasts for a few microseconds.

c. Small defects in the written data and/or track not detected during the write operation which may cause a soft error during a read.

The following procedures are recommended to recover from the above mentioned soft errors:

1. Reread the track 10 times or until such time as the data is recovered.

2. If data is not recovered after using step 1, access the head to the adjacent track in the same direction previously moved, then return to the desired track.

3. Repeat step 1.

4. If data is not recovered, the error is not recoverable.

Errors attributed to the diskette will not be included in determining the nonrecoverable read error rate.

3.3.9.3 Seek Errors

Seek errors rarely occur unless the stepping rate of 5 msec is significantly exceeded. In the event of a seek error, recalibration of track location is achieved by positioning the read/write heads to Track 00 as described in Section 3.3.5.

SECTION IV

THEORY OF OPERATION

4.1 BLOCK DIAGRAM DESCRIPTION

The RFD960 and RFD480 are designed as peripheral devices to be attached to or made part of a host system. Their functional characteristics include the ability to:
(1) receive and generate control signals,
(2) position the read/write heads to selected tracks and
(3) write or read data from the diskette as directed by the host.
Figure 4-1 shows the functional Block Diagram for the RFD960 and RFD480. The RFD480 and RFD960 are similar units except for the density and capacity of each drive as described in Section 1.1 and specified in Table 1-1. The RFD480 has a track density of 48 tracks per inch and the RFD960 has a track density of 96 tracks per inch.

4.1.1 DISKETTE DRIVE MECHANISM

The diskette spindle is driven at 300 RPM by a direct drive, brushless, DC motor. A closed loop servo controls the motor speed to ± 1% of nominal. The speed control circuitry provides better stabilization of the data stream and reduces jitter. This circuitry is mounted on a second P.C. Card as part of the Drive Motor Assembly.

4.1.2 HEAD POSITIONING MECHANISM

A split band/stepper motor system positions the read/write heads. A two phase stepper motor assembly is set up so that each 1.8° (RFD960) or 3.6° (RFD480) rotation of the stepper motor moves the read/write head precisely one track.

4.1.3 READ/WRITE HEAD

The read/write heads incorporate a tunnel erase structure to trim the data track. Their contact surface is made of a ceramic material designed for maximum head life and minimum head and diskette wear. No head load solenoids are used. Media wear and damage are reduced by eliminating "tap, tap" loading in conjunction with the spindle motor starting and stopping. The heads are loaded continuously with a force of 18 ± 2 grams acting upon the head center by a spring which is activated when the drive door is closed. The tunnel erase gaps are part of the complete head but trail the read/write gap in the direction of media rotation. They trim the effective track width to 13 mils (RFD480) or 6 mils (RFD960).

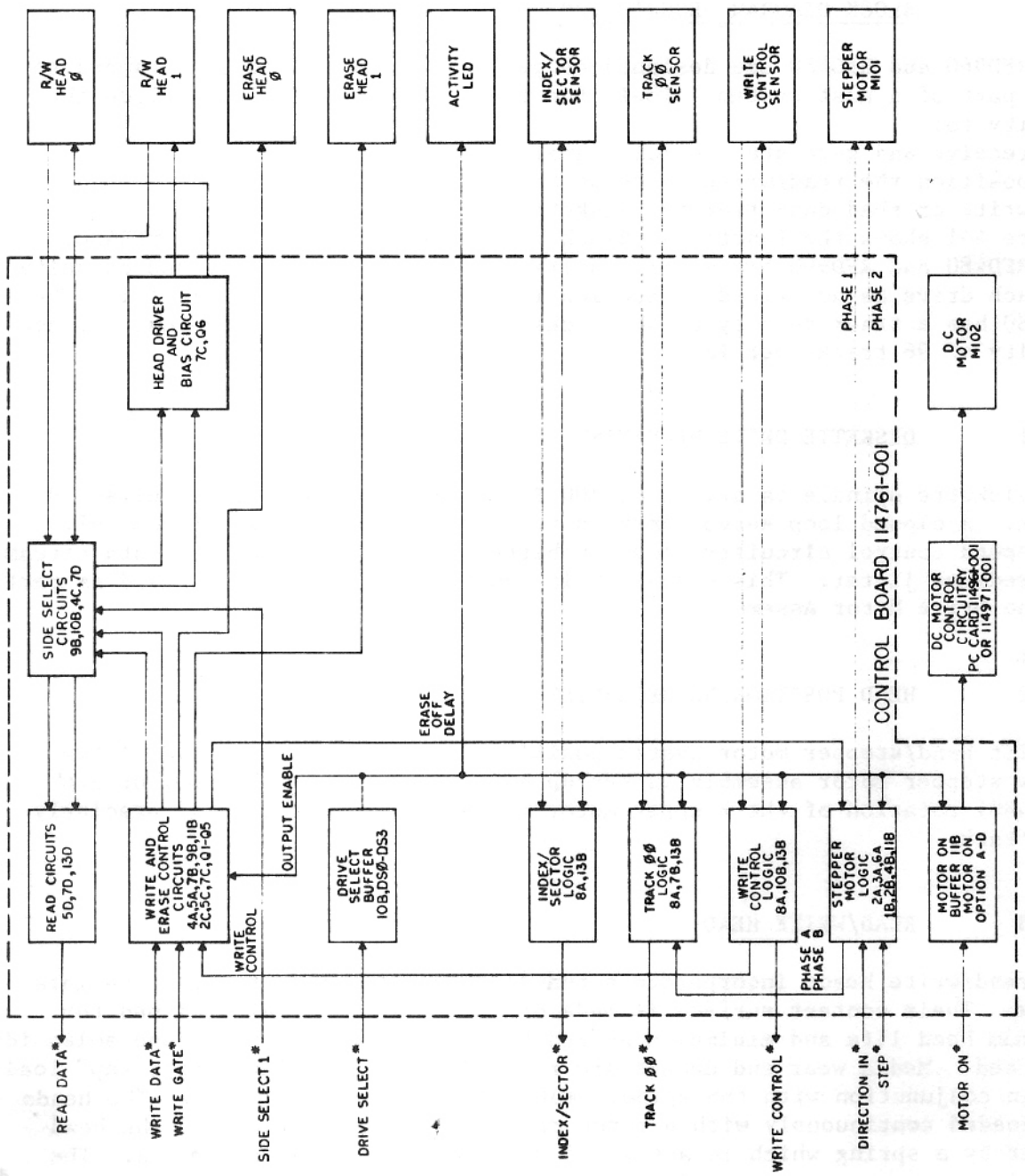


Figure 4-1. Block Diagram of RFD480 and RFD960.

4.1.4 DRIVE ELECTRONICS

The electronics for the operation of the diskette drive are mounted on two printed circuit boards. The main circuit card routes all input and output signals for reading and writing and for drive control functions. It also routes the Motor On* command to the motor control board. This card regulates the speed of the drive motor.

The drive is enabled by the appropriate Drive Select* line which generates the Output Enable signal that is used to enable many of the drive circuits. Figure 4-1 shows the block diagram for the various functions and the circuits enabled by the Output Enable signal.

The Write/Erase circuits require enabling by the Write Gate* signal as well as the Output Enable signal. Side selection is determined by the Side Select 1* signal which switches the write or read data to or from the desired head. If the Write Gate* signal is false, the read circuitry is enabled.

Step motor control is accomplished by the Direction In* and Step* lines provided the erase delay circuit is off (i.e., writing circuits are off). These signals control the stepper motor logic circuitry which determine the state of the stepper motor coils. Two outputs from this circuit, phase A and phase B, are used in conjuction with the optical track sensor to generate the active Track 00* output.

The Index/Sector Sensor and Output Enable commands generate the Index/Sector* output signal. The Write Control Sensor senses the presence of a write protected diskette. It is gated with Output Enable to give the Write Control output signal.

A buffer receives the Motor On* signal and applies it to the D.C. Motor Control Circuitry. The D.C. Motor Circuitry regulates the speed of the spindle motor. Refer to Section 2.3.2 and Table 2-2 which describes Motor Control options and the various methods of controlling the drive and stepper motors.

4.2 FUNCTIONAL DESCRIPTION, CONTROL BOARD 114761-001

The following paragraphs describe the functional operation of the disk drive electronic circuits as used on P.C. Card 114761-001. In some cases functional block diagrams are used to illustrate circuit operation. When references are made to the schematic, the sheet and zone number are included to enable the reader to find the specific component or logic element easily and quickly. The schematic sheet and zone references appear as parenthetic suffixes. E.g., the drive select jumpers are located at (2C8), i.e., sheet 2, zone C8. Figure 8-2 (5 sheets) gives the schematic pages for the drive card. The overall system schematic is shown in Figure 8-1. Also refer to Section 2.4 for logic signal level definitions.

The 114761-001 circuit card is laid out with grid markings 1-13 running horizontally and A-D running vertically. The various ICs used on the cards are identified by a Z followed by the location of these coordinates and are so identified on the schematic (except for the Z). Thus on sheet 2 at D6, the Write Data* is applied to 10B-5 (Z10B, pin 5). 10B then is located at the grid coordinates of 10 and B on the 114761-001 card. Note that the convention used throughout the manual for IC location on the card is the digit followed by the letter, where as on the schematic location (as described in the previous paragraph), the digit follows the letter grid of the schematic coordinate.

4.2.1 DRIVE SELECT CIRCUITRY

Sheet 2 of Figure 8-2 shows the inputs from Drive Select* signal 0-3. For drive 0, pins DS0 are jumpered; for drive 1, pins DS1 are jumpered; for drive 2, pins DS2 are jumpered; and for drive 3, pins DS3 are jumpered. An'L' Drive Select* signal applied to Z10B-1 causes pin 2 (output enable) to go to + 5V. This signal does the following:

(1) enables the Index Sector gate at Z13B-2,
(2) enables the Track 00 gate at Z13B-13,
(3) enables the Write Control gate at Z13B-4,
(4) turns on the Activity LED at Z3C-2,
(5) gates the Write Gate signal at Z9B-4 (3B8) which enables the write circuitry,
(6) enables the read data output circuitry at Z13B-10 (4C2),
(7) enables the step motor circuitry at Z6A-2 (5D7), and is available as an option to turn on the drive motor by jumpering pins B (5A7).

4.2.2 INDEX/SECTOR, TRACK 00 AND WRITE CONTROL CIRCUITS

Sheet 2 shows circuitry for the Index/Sector, Track 00 and Write Control. Each circuit utilizes a phototransistor and hysteresis Schmitt Trigger Circuit Z8A which are either turned off or on depending upon the application. The Index Sector is turned on when the index hole is sensed, causing Z8A-2 to go high. This output is then gated at Z13B-1 with the Output Enable signal and if the drive has been selected, the Index/Sector* output at J1-8 is placed in the 'L' state .

The track 00 sensor is turned on at all times except at track 00 when the sensor beam is interrupted. This causes Z8A-14 to go low which is then gated with the low phase A and phase B outputs from the stepper motor circuitry at Z7B, pins 9-11. When all three inputs are low, Z7B-8 goes high causing the Track 00* output at J1-26 to be at the 'L' state provided the drive is selected (Output Enable is true).

The Write Control sensor detects the presence of the Write Protect notch in the diskette. When the diskette is write protected, the sensor is turned off causing Z8A-1 to go low and Z10B-4 to go high. If the drive has been selected (Output Enable at Z13B-4, high) then the Write Control output at J1-28 goes low, indicating the presence of a write protected diskette. The signal from Z10B-4 is used internally to inhibit writing by shuting off the + 5V voltage monitor circuit on sheet 3 (Q1 and Q2). See Section 4.2.3.

4.2.3 WRITE CIRCUITS

The circuits which control the data information to be written on the diskette are shown on sheet 3 of Figure 8-2. Incoming write data is applied to pin 11 of F/F Z4A (3D8). The rising edge of each pulse in the write data stream triggers the F/F causing it to change states. Each output at pins 9 and 8 is gated at Z7B, pins 13 and 5 with the AND combination of the Output Enable and Write Gate signals from Z9B-6. The results of this gating at Z7B, pins 6 and 12 are then gated with the Side Select signal at Z4C pins 2, 5, 9 and 12 to determine which head is selected. If Side Select is high, head 1 is enabled at Z4C, pins 11 and 13. If Side Select is low, the inverted + 5V signal at Z10B-8 enables head 0 at Z4C, pins 4 and 10. As the F/F changes states, current is driven through one side of the read/write head and then the other. The write amplifiers, Z7C are supplied by a constant current generator, Q6. A write current of 6 ma on RFD960 or 8 ma on RFD480, peak-to-peak, is used on all tracks. R35 adjusts the current to a particular head manufacturer's specification.

The circuit consisting of Q1 and Q2 (sheet 3) serves to monitor the + 5V supply and if it drops below + 3.9 Vdc, the write and erase amplifiers are shut off. When power is first turned on, Q1 is shut off until the voltage reaches approximately + 3.9 Vdc. With Q1 off, Q2 is on causing OV to be applied to the anode of CR17, thereby inhibiting writing and preventing stray data from being written. Q5 is shut off which removes the power source to the erase amplifiers, thereby inhibiting erasing. When the + 5V level goes above + 3.9 Vdc, Q1 turns on, Q2 turns off and Q5 turns on, thereby enabling the write and erase circuits.

4.2.4 ERASE CIRCUITS

The erase element functions as a tunnel erase; i.e., it erases the area on both sides of the Read/Write track rather than the track itself. In this manner, the track is trimmed on both sides as the track is being written which eliminates excessive crosstalk between tracks. This insures interchangeability between diskettes and drives. The erase gaps are located 0.036" behind the read/write gap in the direction of media rotation.

The erase current must be turned on shortly after write data is present. Circuits controlling the automatic erase are shown in Zones B8, B7 and B6 on sheet 3 of Figure 8-2. When the first bit is to be written, the write flip-flop is set and Z4A-9 goes high causing Z7B-6 to go low. Z7B-6, in turn, triggers the 935 µs delay one-shot at Z5A-5. The Q output at Z5A-6, in turn, triggers the 350 µs delay one-shot at Z5A-12. When the Q output (Z5A-9) again goes high, it triggers the Erase F/F at Z4A-3 causing pin 5 to go high. Pin 5 in turn, is gated with Side Select signal at Z3C, pins 5 and 9 causing the erase amplifier for either head 1 or head 0 to be turned on depending upon the side selected. Z5A-5 is a retriggerable one-shot which stays on as long as Z7B-6 changes states. When write data is no longer present, the Q output at Z5A will be reset after the 935 µs time out period. As the Q output goes low, it resets the Erase F/F at Z4A-1 causing the erase amplifier to shut off. Thus, it can be seen that at the beginning of a write operation, the erase current is delayed 350 µs and at the end of write, the erase current remains on for 935 µs before turning off.

4.2.5 POWER ON RESET

Also shown on sheet 3 is the Power On Reset circuitry located in Zones A8, A7 and A6. As power reaches the operating level, C11 charges to the point where Z10B turns on and pin 12 goes low. Before it reaches that point, pin 12 rises sufficiently high to cause Z10B-10 to go to OV. This short, OV Power On Reset signal is used to reset many of the F/F's used throughout the circuit card. When Z10B-13 reaches the level which causes pin 12 to go low, Z10B-10 goes high and the Power On Reset pulse is removed.

4.2.6 READ CIRCUITS

Sheet 3 of Figure 8-2 shows the analog switch (Z7D;3C5) which is used to switch the head signals to the read circuits whenever the internal Write Gate signal is at OV. OV at Z9B-5 (3B8) causes Z9B-6 to go high and either Z9B-11 or Z9B-3 to go to OV depending upon which side is selected. OV applied to Z7D, pins 8 and 9 selects head 0 as the head output signals and OV applied to Z7D, pins 1 and 16 switches head 1 to the head output signals.

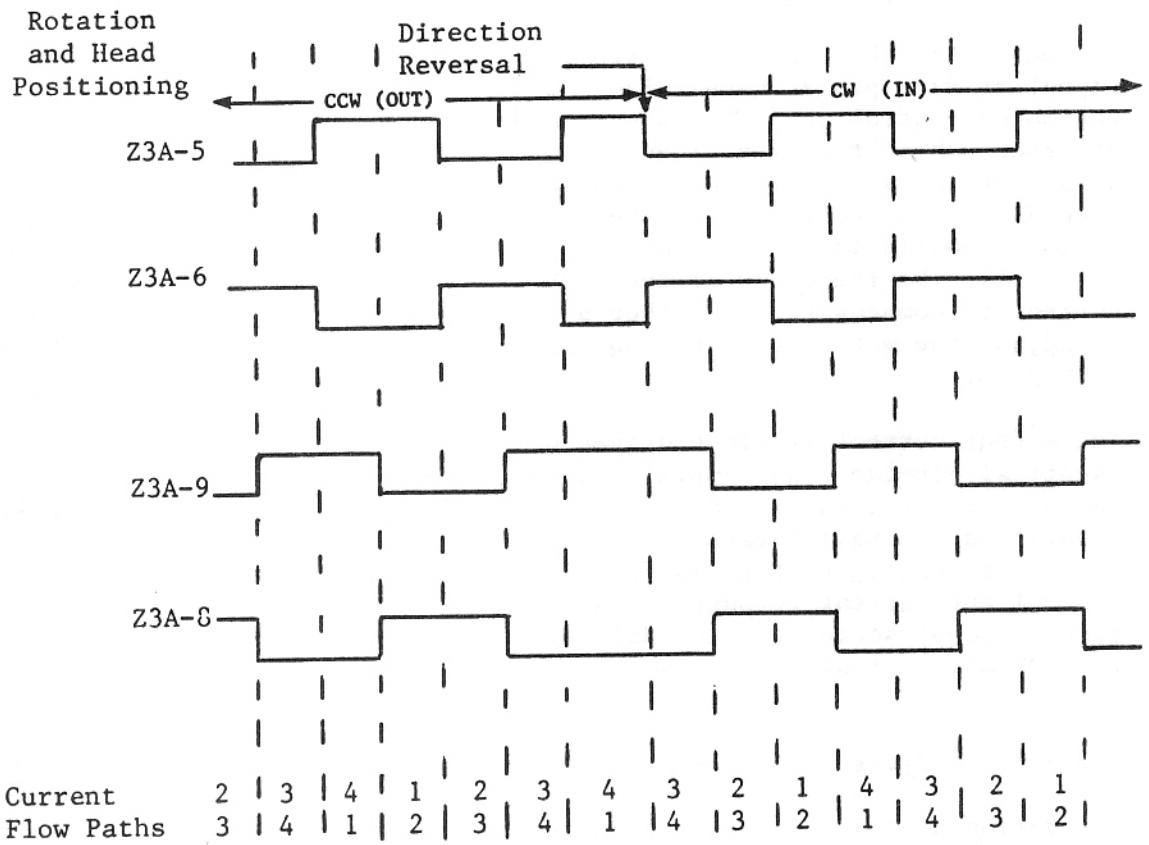
Sheet 4 of Figure 8-2 shows the head output signals being applied to the read circuits. This circuit makes use of the Motorola MC3470 (Z5D) Read Amplifier. The signal received from the head is approximately in the form of a sine wave. This signal is amplified at pins 16 and 17 of Z5D, filtered by the L2-L5 low pass filter (TP7, TP8) and differentiated by the next amplifier stage. The differentiated signal is then applied to the zero cross-over detector and a series of pulse generating circuits which give a positive going 1 ns pulse at TP4. If the drive is selected (Output Enable is active) then a negative going pulse is produced at J1-30. The output signal is a composite of both read and clock pulses.

4.2.7 STEP MOTOR DRIVE CIRCUITS

The step motor control circuits are shown on page 5 of Figure 8-2. A two stage counter composed of the two Z3A flip-flops is used to produce four combinations of drive currents through the motor phases. The counter is stepped with each Step* pulse received at J1-20. The direction of counting and, in turn, the in or out direction of the motor is determined by the Direction In* line at J1-18. When the Direction In* signal is in the 'L' state, it causes the motor to move the head in toward the center and when it is in the 'H' state, it causes the motor to move the head out toward track ØØ.

The motor phases are driven by Z2B amplifiers at pins 1, 14, 7 or 8 depending upon the state of the counter. When Z3A-5 is high, Z1B-13 (5B3) is high which turns on Z1B, Z2B and Z4B at pins 13 causing Z2B-14 to be near OV. Current thus flows thru phase 2 of the stepper motor from Z4B-14 thru J4-11, Phase 2, J4-2 and thru Z2B from pin 14 to pin 12. When Z3A-5 is reset and goes low, the drive amplifier is turned off. Z3A-6 then goes high causing Z1B to turn on at pin 2 and Z2B-1 to go to OV. Z4B, in turn, conducts from pin 3 to 1. Current then thru phase 2 is reversed and flows from Z2B-14 thru J4-2, phase 2 J4-1 and thru Z2B from pin 1 to pin 3.

Figure 4-2 shows the timing diagram and current flow paths for the various configurations of counter outputs.


Rotation and Head Positioning
Direction Reversal
CCW (OUT)
CW (IN)
Z3A-5
Z3A-6
Z3A-9
Z3A-8
Current Flow Paths
2 3 4 1 2 3 4 3 2 1 4 3 2 1
3 4 1 2 3 4 1 4 3 2 1 4 3 2

CURRENT FLOW PATHS

1 is Current Flow from Z4B-12 to Z4B-14 to Phase 2 to Z2B-14 to Z2B-12.

2 is Current Flow from Z4B-10 to Z4B-8 to Phase 1 to Z2B-8 to Z2B-10.

3 is Current Flow from Z4B-3 to Z4B-1 to Phase 2 to Z2B-1 to Z2B-3.

4 is Current Flow from Z4B-5 to Z4B-5 to Phase 1 to Z2B-7 to Z2B-5.

Rotation is viewed from the mounting surface.

MMC 762A

Figure 4-2. Stepper Motor Energizing Sequence.

4.2.8 DRIVE MOTOR CIRCUIT

Direct Motor Drive Assembly 114769-002 using the Japan Servo Motor, REMEX P/N 715075-219 uses P.C. Assembly 114971-001 (See Schematic, Figure 8-3). The drive assembly uses a brushless DC servo motor which uses Hall elements for sensing the position of the motor and a magnetic tachometer. For this loop servo regulates the speed of the motor. Section 4.2.8.1 describes the servo operation for the card.

4.2.8.1 Drive Motor Electronics, Japan Servo, P.C. Assembly 114971-001

Activation of this card is controlled by the Motor On* signal. A false (+ 5V) signal at P3B, pin 3, causes Z2-7 to be high which shuts off the operation of the motor control chip Z1. When the Motor On* signal is true (OV), pin 7 is at ground which releases Z1 and allows it to function. The input to Z1 is the output of the motor tachometer which is a sine wave which subsequently gets shaped into pulses at Z2-1. These pulses are applied to Z1-2 through C2. Z1 is a monolithic IC (M51970L) designed for the speed control of a DC motor. It samples the frequency of the tachometer signal and regulates the output current to compensate for either a too fast or too slow a speed. R30 is used to adjust the motor speed to 300 rpm and the servo will regulate the speed to within 1%.

The output current at pin 6 drives Q1 which supplies current to the three identical bipolar phase amplifiers Q3-Q10. Each amplifier is connected to one of the three motor phases W, V and U which are connected in a delta configuration. A Hall element is used to sense the current in each phase winding and the resulting voltage is fed back to the amplifier as HW, HV and HU which control the current through the W, V and W driver stages. The required constant current source for the Hall elements is supplied by CR1 through P8, pin 1 to the Hall elements and back through P8, pin 2.

4.2.8.2 Drive Motor Electronics, Copel Servo, P.C. Assembly, 114961-001

Activation of this card is controlled by the Motor On* signal. When this signal is false (+ 5V), Q2 is turned on which grounds the output of the D.C. Servo Amplifier which is part of Z3. A true (OV) signal shuts off Q2 and allows the Servo Amplifier to operate. The input to Z3 is the output of the motor tachometer which is a sine wave and is applied across pins 1 and 2 of Z3. Z3 is a UPC 1043C frequency detector, motor control IC. It samples the frequency of the tachometer signal and regulates the current to the Hall element amplifiers to compensate for either a too fast or too slow speed. R11 is used to adjust the motor speed to 300 rpm and the servo will regulate the speed to within 1%. The output of the servo amplifier at pin 10 or Z3 is applied to pin 8 or 21.

4.3 FUNCTIONAL DESCRIPTION, CONTROL BOARD 114861-001

The more recent configurations of the RFD480 and RFD960 use the 114861-001 Control Card in place of the 114761-001 card described in Section 4.2. Except for the following differences, the operation and component content are identical. Figure 8-5 shows the schematic for the 114861-001 card. Table 7-6 gives the parts list for the 114861-001 card.

4.3.1 READY CIRCUIT

A retriggerable one shot Z5B (2D3) is triggered by the first index pulse from Z8A, pin 2. The one shot is set so that if the index pulse repetition rate is 250 ± 50 ms (repetition rate is 200 ± 2 ms when operating speed is reached) the one shot will stay on causing Z5B-6 (and Z3C-1) to be high. If the drive is selected (Z3C-2 is high), Z3C-3 will bo low causing the READY* signal to be low.

4.3.2 STEP MOTOR DRIVE CIRCUITS

The step motor control circuits are shown on Sheet 5 of Figure 8-5. A two stage counter composed of the two Z3A flip-flops is used to produce four combinations of drive currents through the motor phases. The counter is stepped with each Step* pulse received at J1-20. The direction of counting and, in turn, the in or out direction of the motor is determined by the Direction In* line at J1-18. When the Direction In* signal is in the 'L' state, it causes the motor to move the head in toward the center and when it is in the 'H' state, it causes the motor to move the head out toward track ØØ.

The motor phases are driven by the Z2B amplifier at pins 6, 9, 3 or 12 depending upon the state of the counter. When Z3A-5 is high Z3B-9 (5B3) is high which causes Z3B-8 to go low and turn on Q10. Z2B-10 also goes high causing current to flow from Z2B-9 to Z2B-7. Current thus flows thru phase 2 of the stepper motor from + 12V, thru Q10, J4-3, phase 2, J4-4, Z2B-9 to Z3B-7. When Z3A-5 is reset and goes low, the drive amplifier is turned off. Z3A-6 then goes high causing Z3B-6 to go low and Q11 to turn on. Z2B also conducts from pins 6 to 7 at this time causing the current thru phase 2 to be reversed.

Figure 4-2 is identical for the 114861-001 card except the current flow paths are as follows:

1 is current flow from Q10 to J4-3 to Phase 2 to J4-4 to Z2B-9 to Z2B-7

2 is current flow from Q8 to J4-8 to Phase 1 to J4-7 to J2B-12 to Z2B-7

3 is current flow from Q11 to J4-4 to Phase 2 to J4-3 to Z2B-6 to Z2B-7

4 is current flow from Q9 to J4-7 to Phase 1 to J4-8 to Z2B-3 to Z2B-7

SECTION V

MAINTENANCE

5.1 GENERAL

The RFD480 and RFD960 drives have been manufactured and assembled with precision and to tight tolerances. Because of the advanced technical features of the drives, various specialized equipment, tools and fixtures have been used in their production. Each assembly step is dependent upon locating that part in a precise relationship to other parts. As a result, except for the adjustments given in Section 5.3 and the replacement procedures in Section 6, REMEX does not recommend field servicing or repair of the drive unless the user has been factory trained and has the required assembly tools and fixtures and the necessary test and calibration equipment. For those recommended procedures in Sections 5 and 6, Table 5-1 lists the maintenance equipment required.

Table 5-1. Maintenance Equipment Required

Item	Quantity
Alignment Diskette, RFD480 or RFD960, Dymak DK501-8 (REMEX P/N 716083-031)	1
(1) Dual Trace Oscilloscope, Tektronix 465 or equivalent with matched 1:1 probes.	1
(2) Taptite Driver #4, Torx Part Number TX-09 (REMEX P/N 716056-125)	1
(2) Taptite Driver #6, Torx Part Number TX-15 (REMEX P/N 716056-126)	1
(1) (3) Torque Wrench, Torque Controls TS-30	1
(1) Multimeter, Digital, Ballentine 3028B or equivalent	1
(1) (2) Torque Drive Adapter Apex 49-TX09	1
(1) (2) Torque Drive Adapter Apex 49-TX15	1

(1) These items are not available from REMEX.

(2) Taptite Drivers #4 and #6 and Torque river Adapters 49-TX09 and 49-TX15 are also available from Apex Machine and Tool, Dayton, Ohio.

(3) This item is available from Torque Controls, Orangeburg, So. Carolina.

Figure 7-1 shows the interrelationship of the various parts. This figure along with Figures 7-2 and 7-3 are given for reference only for those who have been qualified to work on the drives. Certain parts require critical alignment and adjustment. These include the Direct Drive Motor (item 6, Figure 7-1), the clutch assembly which is part of the Front Bezel/Clutch Assembly (item 2, Figure 7-1), the Carriage Assembly (item 19, Figure 7-1), the Load Arm/Media Guide (item 9, Figure 7-1) and the Stepper Motor (item 13, Figure 7-1).

Special locating fixtures required in the assembly of the drive include the Track 00 Locating Fixture, the Bezel and Clutch Assembly Fixture and the Drive Motor Locating Fixture. Proper alignment requires that the drive motor and the clutch assembly be installed with accuracy to insure that the placement and rotation of the diskette is correct and consistant. The stepper motor and carriage assembly are then aligned with a certified alignment diskette using the REMEX exerciser. It can be seen that the removal and replacement of any of these parts requires a complete alignment of the drive.

5.2 PREVENTIVE MAINTENANCE

No preventive maintenance is recommended by REMEX and no lubrication of the drive is required or should be attempted. Furthermore, head cleaning is not required and should not be performed. It is important that the drive be used in an environment which is free of excessive contaminants. When the drive has been removed from its installation it is essential that it be kept free from smoke, dirt, lint or dust which can degrade the performance of the drive and possibly ruin the diskette data or damage the read/write heads.

5.3 ADJUSTMENTS

The only adjustments that are recommended are given in this section.

5.3.1 MOTOR SPEED ADJUSTMENT

The following adjustment sets the speed of the drive motor:

a. Connect P1/J1 and P2/J2 on the drive so that all power and control signals are applied.

b. Connect an oscilloscope probe to TP3 on the Control P.C. Card and set the time division on the oscilloscope for 20 msec/division.

c. Insert a diskette and observe that the index pulse is 200 msec ± 2 msec. As a check, the dark lines of the tach disc on the spindle motor should appear motionless.

d. If the conditions of step c do not exist, adjust R30 on the Motor Control Card 114971-001 until the conditions of step c exist.

5.3.2 INDEX ALIGNMENT

The following procedure sets index alignment:

a. Connect P1/J1 and P2/J2 on the drive so that all power and control signals are applied.

b. Set the oscilloscope switches and probes as follows:

Channel 1:	TP5	V MODE:	ADD
Channel 2:	TP6	V/DIV:	50 MV/AC
Ground:	TP9	INP COUPL:	DC
T/DIV:	50 µsec	TRIG:	+
Source:	External Probe Connects To Z13B, Pin 13	CH2:	INVERT

c. Insert alignment diskette. See Table 5-1.

d. Select side 0.

e. Step to track 01 for the RFD480 or to Track 02 for the RFD960.

f. Observe scope. The data burst pulse should occur 200 ± 50 µsec from the triggered edge.

g. If the conditions of step f do not exist, use Taptite Drive #4 and loosen screws 1 and 2 shown in Figure 7-4 (screws B in Figure 7-1) which hold the Load Arm/Media Guide (item 9, Figure 7-1) to the chassis. Position the Load Arm/Media Guide slightly until the conditions of step f are achieved.

h. Tighten the two screws with a torque wrench set at 4 inch-lbs.

5.3.3 TRACK 00 ADJUSTMENT

The following procedure sets the Track 00 opto switch adjustment:

a. Connect P1/J1 and P2/J2 on the drive so that all power and control signals are applied.

b. Connect a digital voltmeter with the red clip connected to Z8A, pin 8 and the black clip connected to Z8A, pin 12. A 14 pin D.I.P. clip attached to Z8A will facilitate this step.

c. Step to track 02. The voltage at Z8A - 8 should be less that 0.8 Vdc.

d. Step to track 01. The voltage at Z8A - 8 should be greater than + 3.0 Vdc.

e. Step to track 00. The voltage at Z8A - 8 should be greater than + 3.0 Vdc.

f. If the conditions of steps c, d and e do not exist, use a Taptite Drive #4 and loosen screw J in Figure 7-1 which holds the track 00 bracket to the chassis and position the bracket slightly until the conditions of steps c, d and e are achieved.

g. Tighten screw J with a torque wrench set at 4 inch-lbs.

SECTION VI

DISASSEMBLY PROCEDURES

6.1 GENERAL

Because of the precision with which the drive is assembled and the special techniques and equipment required (See Section 5.1), it is recommended that the only disassembly procedures to be performed are those given in this section.

6.2 REPLACEMENT OF CONTROL (P.C. CARD 114761-001 or 114861-00X)

The following procedure should be followed when replacing the Control P.C. Card:

a. Remove all power and control signals from the drive by disconnecting P1/J1 and P2/J2. See Figure 2-2 for location of these connectors.

b. Disconnect P3A/J3A, P3B/J3B, P4/J4, P5/J5 and P6/J6. See Figure 7-4 for the location of these connectors.

c. Using a Taptite driver #4, remove the two 4-40 taptite screws near the front of the drive which hold P.C. Card to the mainframe. The card is now free for removal.

d. Replacement is the reverse of steps c, b and then a. When replacing the two 4-40 taptite screws, use a torque wrench set to 6 inch-lbs.

6.3 REPLACEMENT OF MOTOR DRIVE BOARD 114971-001

The following procedure should be followed when replacing either Motor Drive Board 114971-001:

a. Remove all power and control signals from the drive by disconnecting P1/J1 and P2/J2. See Figure 2-2 for location of these connectors.

b. Disconnect P8/J8 (See Figure 7-6) at the motor and P3B/J3B (See Figure 7-4) on the Control Card. The card is now free for removal.

c. Using a Taptite driver #4, remove the 4-40 taptite screw which holds the circuit card to the mainframe.

d. Replacement is the reverse of steps c, b and then a. When replacing the 4-40 taptite screw, use a torque wrench set to 4 inch-lbs.

e. Perform Section 5.3.1.

6.4 FRONT BEZEL/CLUTCH ASSEMBLY REPLACEMENT

The following procedure is recommended when replacing the Front Bezel/Clutch Assembly:

a. Close the front door.

b. Remove the Control P.C. Card Assembly. Refer to Section 6.2, steps a, b and c.

c. Unplug connector P3G which connects to the phototransistor sensor on the top. See Figure 7-5.

d. Unplug connector P3H which connects to the LED on the bottom. See Figure 7-6.

e. Using Taptite driver #6, remove the two screws (item E, Figure 7-1) which hold the Front Bezel/Clutch Assembly to the chassis. The Front Bezel/ Clutch Assembly is now free.

f. At this level the Write Control Phototransistor (item 15, Figure 7-2) on the top can be replaced. On older units, the phototransistor will be bonded to the Bezel Assembly. A sharp tool will be needed to scrape out the bonding material. On newer units the phototransistor is press fit and only needs to be pulled out. Note the orientation of the flat on the phototransistor so it can be replaced in the same configuration.

g. To install the new phototransistor align the phototransistor so that the flat side is toward the nearest side of the bezel (same orientation as noted in step f). Later model units have the flat indicated in the hole so that it is only necessary to align the two flat sides.

h. Clip the leads to match the length of the ones being replaced.

i. Bend the leads to match those being replaced.

j. To replace the Write Control LED (item 12, Figure 7-2) on the bottom, remove the old LED which is pressed in. Note the orientation of the flat on the LED so that it can be replaced in the same configuration.

k. Install the new LED so that the flat is to the front.

l. Clip the leads to match the length of the one being replaced.

m. Reassembly of the Front Bezel/Clutch Assembly is the reverse of steps e, d, c and b. When installing the Front Bezel/Clutch Assembly, make sure the clutch is properly seated in the motor assembly and the index pins (items B and C, Figure 7-2) are installed in slots FF and GG (Figure 7-1) located in the chassis. When performing the reverse of step e, tighten screws E using a torque wrench set to 8 inch-lbs.

6.5 WRITE CONTROL PHOTOTRANSISTOR REPLACEMENT

To replace the Write Control Phototransistor, perform Section 6.4, steps a, b, c, d, e, f, g, h, i and m.

6.6 WRITE CONTROL LED REPLACEMENT

To replace the Write Control LED, perform Section 6.4, steps a, b, c, d, e, j, k, 1 and m.

6.7 EJECTOR AND EJECTOR SPRING REPLACEMENT

The following procedure is recommended when replacing the Ejector and/or Ejector Spring:

a. Remove the Control P.C. Card Assembly. Refer to Section 6.2, steps a, b and c.

b. Remove the Motor Drive Board. Refer to Section 6.3, steps a, b and c.

c. Remove the spring (item 20, Figure 7-1) from the Ejector (item 7, Figure 7-1).

d. Note the orientation of the Ejector so it can be replaced in the same configuration.

e. Slide the Ejector to the rear of the drive until it can be removed through the slot.

f. Install the new ejector in the opposite manner of step e. It may be necessary to lift the Load Arm (item 9, Figure 7-1) to slide the Ejector to the front.

g. Install the spring on the new ejector.

h. To replace the spring, it is necessary to remove the bonding agent which holds the front end of the spring to the chassis. The bonding agent is used to simplify assembly. It is not needed when replacing the spring. Simply hook the chassis side of the spring to the pin on which the bonding agent was attached.

i. Reassembly is the reverse of steps c, b and then a.

6.8 LOAD ARM/MEDIA GUIDE ASSEMBLY REPLACEMENT

The following procedure is recommended when replacing the Load Arm/Media Guide Assembly:

a. Close the front door.

b. Remove the Control P.C. Card Assembly. Refer to Section 6.2, steps a, b and c.

c. Unplug connector P3C which connects to the Index Phototransistor. See Figure 7-5.

d. Using a Taptite Driver #4, remove the two screws and washers (items B and Z, Figure 7-1) which hold the Load Arm/Media Guide Assembly to the chassis.

e. At this point, the index phototransistor can be replaced by removing the old phototransistor,which is a press fit, and installing the new one. Note the orientation of the one being removed and install the new one so that the flat is in the same location.

f. Clip the leads to the same length as the phototransistor being removed and bend the leads into the same configuration.

g. Replacement is the reverse of steps d, c and then b. Use a torque wrench set to 4 inch-lbs when tightening screws B.

h. Perform Index Alignment procedure, Section 5.3.2.

6.9 TRACK 00 OPTO SWITCH REPLACEMENT

The following procedure is recommended when replacing the Track 00 Opto Switch:

a. Remove the Control P.C. Card Assembly. Refer to Section 6.2, steps a, b and c.

b. Remove the Motor Drive Board. Refer to Section 6.3, steps a, b and c.

c. Unplug the two connectors P3E and P3F which connect to the Track 00 Opto Switch. See Figures 7-5 and 7-6 for location of P3E and P3F.

d. Using a Taptite Drive #4, remove screw J and washer R which holds the Track 00 bracket (item 10, Figure 7-1) to the chassis.

e. Using a Taptite Drive #4, loosen the two screws H (Figure 7-1) which hold the Track 00 Opto Switch (item 25, Figure 7-1) to the Track 00 bracket. Note the orientation of the Track 00 Opto Switch so that it can be replaced in the same way. It is important that the white dot be visible when mounted in the bracket and positioned to the bottom of the drive. See Figure 7-1.

f. Reassembly is the reverse of steps e, d, c, b and then a. When performing the reverse of step d, lightly tighten screw J so that step g can be performed. Tighten screws H using a torque wrench set to 4 inch-lbs.

g. Align the Track 00 Opto Switch by performing Section 5.3.3.

SECTION VII

PARTS LIST

7.1 GENERAL

This section lists the electronic and mechanical parts used on the RFD480 and the RFD960. Standard hardware items are not listed. Table 7-1 lists the recommended spare parts and the quantity column denotes the number recommended. Table 7-2 lists the electronic and mechanical parts used in both the RFD480 and the RFD960. Table 7-3 and Table 7-4 contains the components used on the main printed circuit card and the two types of motor control cards. Figures 7-1 thru 7-6 illustrate the parts listed in Table 7-2. Those items identified by a broken arrow indicate the approximate location of parts not visible in the photograph.

Indented items are part of the assembly under which they are indented and the quantity of these items are per each assembly. Reference designations refer to the parts illustrated in Figures 7-1 thru 7-6 . The reference disignations include a figure number and a part designation number which appears on that figure. For example, in Table 7-2, the reference designation for the Mainframe is 7-1; 3, i.e., item 3, Figure 7-1. All eletronic components are identified by letter-number combinations such as C1 and R1. Mechanical parts are identified by number only. Reference designations in parentheses are associated with the parenthetical item. These items are generally individual items and not part of the referenced assembly, but are related back to the associated item for ease of location and association.

All parts are available from: REMEX Spares Order Desk
2991 White Star
Anaheim, CA 92806

NOTE: WHEN ORDERING SPARE PARTS, CONTACT REMEX SPARES ORDER DESK AND REFERENCE COMPLETE MODEL AND SERIAL NUMBER OF UNIT. ALWAYS REFER TO ADDENDUM AT THE REAR OF THE MANUAL (IF APPLICABLE) FOR POSSIBLE PART NUMBER CHANGES.

Table 7-1. Recommended Spare Parts, RFD480 and RFD960.

Description and Manufacturer's Part No.	REMEX Part No.	Quantity	Reference Designation
Ejector	114944-001	1	7-1;7
Ejector Spring	114946-001	1	7-1;20
Front Bezel/Clutch Assy, 2.10" Bezel, Black	114854-001	1	7-1;2
Front Bezel/Clutch Assy, 3.40" Bezel, Black	114854-002	1	7-1;2
Front Bezel/Clutch Assy, 2.10" Bezel, White	114854-021	1	
Jumper Plugs, PCB (2 Contact Connector) AMP 531220-2	706510-361	2	DSO-DS3,A-D,RDY
LED, Write Control (part of Front Bezel/ Clutch Assembly)	704004-013	1	7-2;15
Load Arm/Media Guide Assembly (includes Diskette Load Pad, Bail, Media Guide and Index Phototransistor)	114775-001	1	7-1;9
Media Guide/P.C.B. Mount	114692-001	1	7-1;17
Phototransistor, Write Control (part of Front Bezel/Clutch Assembly)	704214-021	1	7-2;12
Printed Circuit Card, Control (earlier units)	114761-001	1	PC1
Printed Circuit Card, Control (later units), RFD480	114861-001	1	PC1
Printed Circuit Card, Control (later units), RFD960	114861-002	1	PC1
Printed Circuit Card, Japan Servo	114971-001	1	7-1;21
Track 00 Opto Switch, Spectronics SPX-1879-15	704214-020	1	7-1;25

NOTE: WHEN ORDERING SPARE PARTS, CONTACT REMEX SPARES ORDER DESK AND REFERENCE COMPLETE MODEL AND SERIAL NUMBER OF UNIT. ALWAYS REFER TO ADDENDUM AT THE REAR OF THE MANUAL (IF APPLICABLE) FOR POSSIBLE PART NUMBER CHANGES.

Table 7-2. Parts List, RFD480 and RFD960.

Description and Manufacturer's Part No.	REMEX Part No.	Quantity	Reference Designation
RFD480, Low Profile Bezel	814689-001	1	Ref.
RFD960, Low Profile Bezel	814689-002	1	Ref.
RFD480, High Profile Bezel	814689-003	1	Ref.
RFD960, High Profile Bezel	814689-004	1	Ref.
This Assy is the same as 814689-001 except uses Front Bezel Assy. 114854-026, RFD480, with Colored Door	814689-021		
This Assy is the same as 814689-002 except uses Front Bezel Assy. 114854-021, RFD960, with Colored Door	814689-022		
The following subassemblies are identical to all assemblies unless specifically noted.			
. Bracket, Track 00 Switch	114667-001	1	7-1;10
. Carriage Assembly, RFD480	114738-001	1	7-1;19,Ref 7-3
. . Band Assembly	114732-002	1	7-3;3
. . . Band	114604-001	1	7-3;4
. . . Spring, Extension	114243-001	1	7-3;4
. . Head Carriage Assembly	114760-001	1	7-3;1
. Carriage Assembly, RFD960	114738-002	1	7-1;19,Ref 7-3
The subassemblies are identical to 114738-001 except:			
. . Head Carriage Assembly	114760-002	1	7-3:1
. Clamp, Guide Rod	114658-001	1	7-1;18
. Clamp, Guide Rod	114656-001	1	7-1;12
. Ejector	114944-001	1	7-1;7
. Front Bezel/Clutch Assy, Low Black	114854-001	1	7-1;2, Ref.7-2 ef.7-2
. Front Bezel/Clutch Assy, High Black	114854-002	1	
. Front Bezel/Clutch Assy, Low White	114854-021	1	
. Profile Used on Assys 814689-001,-002			7-2;7
. . Bezel, Front, Low Profile	114853-001	1	7-2;10
. . Clutch Assy	114607-001	1	7-2;16
. . Clutch Lever	114663-002	1	7-2;3
. . Door	114865-001	1	7-2;A
. . Drive Stud, N. 2, Groov-Pin Corp	713680-109	1	7-2;1
. . Holder, Spring	114852-001	1	7-2;5
. . Latch, Door	114668-001	1	7-2;15
. . LED, Write Control Sprctronics SEP8505-3	704004-013	1	7-2;12
. . Phototransistor, Write Control Spectronics SPD8405-3	704214-021	1	7-2;4
. . Pin, Hinge	114818-001	1	7-2;14
. . Roller, Needle 1/8" dia x 1/2" long	713660-103	1	

NOTE: WHEN ORDERING SPARE PARTS, CONTACT REMEX SPARES ORDER DESK AND REFERENCE COMPLETE MODEL AND SERIAL NUMBER OF UNIT. ALWAYS REFER TO ADDENDUM AT THE REAR OF THE MANUAL (IF APPLICABLE) FOR POSSIBLE PART NUMBER CHANGES.

Table 7-2. Parts List, RFD480 and RFD960 (Continued).

Description and Manufacturer's Part No.	REMEX Part No.	Quantity	Reference Designation
. Front Bezel/Clutch Assembly, (Cont'd)			
. . Sleeve, Clutch	114824-001	1	7-2;11
. . Spring, Compression, Clutch	114819-001	1	7-2;8
. . Spring, Door	114743-001	1	7-2;2
. . Spring, Latch	114674-001	1	7-2;13
. . Washer, Bearing	114665-001	1	7-2;9
. Front Bezel/Clutch Assembly, High Black Profile. Used on assemblies 814689-003, 004.	114854-002	1	7-1;2, Ref.7-2
. . Bezel, Front, High Profile Black	114853-002	1	7-2;7
. Guide, Rod, Long	114733-001	1	7-1;26
. Guide, Rod, Short	114734-001	1	7-1;27
. Holder, Index	114802-001	1	7-1;4
. Label, Product Identification	114985-001	1	7-1;11
. LED, Index, Spectronics SEP8505-3	704004-013	1	7-1;5
. Load Arm/Media Guide Assembly	114775-001	1	7-1;9
. . Load Arm/Media Guide Molded Assy.	114686-001	1	
. . Pad, Diskette Load	114764-001	1	
. . Phototransistor, Index, Spectronics SPD8405-3	704214-021	1	
. Mainframe	114538-001	1	7-1;3
. Media Guide/P.C.B. Mount	114692-001	1	7-1;17
. Motor, Direct Drive Assembly, Japan Servo	114769-002	1	7-1;22
. . Decal, Visual Tach	114688-001	1	

NOTE: WHEN ORDERING SPARE PARTS, CONTACT REMEX SPARES ORDER DESK AND REFERENCE COMPLETE MODEL AND SERIAL NUMBER OF UNIT. ALWAYS REFER TO ADDENDUM AT THE REAR OF THE MANUAL (IF APPLICABLE) FOR POSSIBLE PART NUMBER CHANGES.

Table 7-2. Parts List, RFD480 and RFD960 (Continued).

Description and Manufacturer's Part No.	REMEX Part No.	Quantity	Reference Designation
. Motor, Direct Drive, Japan Servo (Cont'd)			
. . Motor, Direct Drive, REMEX Specification	715075-219	1	7-1;22
. . P.C. Board Assembly, See Table 7-5	114971-001	1	7-1;21
. Plate, Stepper Motor	114659-001	1	7-1;14
. Printed Circuit Card, Control(earlier units) See Table 7-3 for subassemblies	114761-001	1	7-1;1
. Printed Circuit Card, Control, RFD480 (later units).See Table 7-6 for subassemblies.	114861-001	1	7-1;1
. Printed Circuit Card, Control, RFD960 (later units).See Table 7-6 for subassemblies.	114861-002	1	7-1;1
. Set Screw, 4/40 x 1/2", Track 00 stop	713020-708	1	7-1;HH
. Spring, Extension	114946-001	1	7-1;20
. Spring, Stepper Motor Adjust, Associated Spring Co. C0240-026-0880	714090-149	1	7-1;15
. Spring Grip, Fastener, Fastex 8-63-12-06	715025-161	1	7-1;C
. Step Motor Assembly, RFD480	114885-001	1	7-1;13
. Step Motor Assembly, RFD960	114886-001	1	7-1;13
. Track 00, Opto Switch, Spectronics SPX-1879-15	704214-020	1	7-1;25
. Wire Harness Optics	114936-001	1	
. . Connector, Housing, 14 pin Berg 65043-030	706510-362	1	P3A
. . Connector, Housing, 2 pin Berg 65039-035	706510-351	6	P3C-P3H
. . Contact, Connector, Berg 48245	706530-142	12	(P3A)
. . Contact, Connector, Berg 75374-019	706530-191	12	(P3C-P3H)
. . Key, Polarizing, Berg 65307-001	706540-160	1	(P3A)

NOTE: WHEN ORDERING SPARE PARTS, CONTACT REMEX SPARES ORDER DESK AND REFERENCE COMPLETE MODEL AND SERIAL NUMBER OF UNIT. ALWAYS REFER TO ADDENDUM AT THE REAR OF THE MANUAL (IF APPLICABLE) FOR POSSIBLE PART NUMBER CHANGES.

Table 7-3. Printed Circuit Card Assembly, 114761-001 Control Board.

Description and Manufacturer's Part No.	REMEX Part No.	Quantity	Reference Designation
The following parts list was written for the X_{14} assembly and the X_9 schematic revisions. Subsequent changes are contained on a P.C. Card Change Record for contained in the addendum.			
Capacitor, 0.1 µf, 50V, Ceramic West-Cap X512BZ104Z	702141-106	10	C1,8,10,11,13, 15,20,23,25,27
Capacitor 1000 pf, 50V, Ceramic West-Cap X512BY102J	702141-103	2	C2,C16
Capacitor, 4700 pf, 50V, Ceramic West-Cap X519BY472J	702141-104	1	C3
Capacitor, 22 µf, 25V, Electrolytic, Illinois Capacitor 224TTA025A	702641-226	10	C4-C7,C9,C12, C18,C19,C26
Capacitor, 510 pf, 50V, Cermic Corning CAC02C0G511J050A	702141-107	1	C14
Capacitor, 100 pf, 50V, Ceramic West-Cap X511BY101	702141-101	1	C21
Capacitor, 390 pf, 100V, Ceramic West-Cap X511BY391J	702141-115	1	C22
Capacitor,0.22 µf, 50V, Ceramic, Monolithic AVX 5R305C224KAA	702131-108	1	C24
Choke, 33 µH, West-Cap DINK-33	702500-125	1	L1
Choke, 82 µH, West-Cap DINK-82	702500-122	2	L2,L3
Choke, 330 µH, West-Cap DINK-330	702500-130	2	L4,L5
Choke, 150 µH, West-Cap DINK-150	702500-126	3	L6,L7,L8
Connector, 4 pin, Right Angle Amp 641737-1	706500-357	1	J2
Connector, 18 pin, Right Angle Amp 65626-114	706500-364	1	J3
Connector, 10 pin, Right Angle Amp 65626-110	706500-360	1	J4
Connector, 6 pin, Right Angle Amp 65592-106	706500-361	2	J5,J6
Connector, 2 Contact, AMP531220-2	706510-361	4	(DS0-DS3,A-D,RDY)
Diode, 1N4148	704000-112	26	CR1-CR26
Diode, Zener, 3.3V, 1N5226B	704010-129	1	VR1
I.C. Package, 74LS86	704620-086	1	2A
I.C. Package, 74LS74	704620-074	2	3A,4A
I.C. Package, 96LS02	704621-004	1	5A

NOTE: WHEN ORDERING SPARE PARTS, CONTACT REMEX SPARES ORDER DESK AND REFERENCE COMPLETE MODEL AND SERIAL NUMBER OF UNIT. ALWAYS REFER TO ADDENDUM AT THE REAR OF THE MANUAL (IF APPLICABLE) FOR POSSIBLE PART NUMBER CHANGES.

Table 7-3. Printed Circuit Card Assembly, 114761-001 Control Board (Continued).

Description and Manufacturer's Part No.	REMEX Part No.	Quantity	Reference Designation
I.C. Package, 74LS10	704620-010	1	6A
I.C. Package, LM339	704520-156	1	8A
I.C. Package, 74LS27	704620-027	1	7B
I.C. Package, 1CL7660	704810-150	1	8B
I.C. Package, 74LS00	704620-000	1	9B
I.C. Package, 7414	704600-150	1	10B
I.C. Package, 74LS14	704620-014	1	11B
I.C. Package, 7438	704600-149	1	13B
I.C. Package, 7426	704600-151	2	3C,4C
I.C. Package, MC3470	704810-148	1	5D
I.C. Package, DG211	704810-147	1	7D
I.C. Package, Resistor 47K	701900-031	1	7A
I.C. Package, Resistor 220/330 ohm	701900-011	1	12B
LED, General Instrument MV5021	704004-006	1	DS1
Resistor, 470 ohm, 1/4W, ± 5%	701003-471	6	R1-R4,R13,R23
Resistor, 910K, 1/4W, ± 5%	701003-914	1	R5
Resistor, 680K, 1/4W, ± 5%	701003-684	1	R6
Resistor, 100 ohm, 1/4W, ± 5%	701003-101	4	R7,R8,R38,R39
Resistor, 2.2K, 1/4W, ± 5%	701003-222	1	R9
Resistor, 3.3K, 1/4W, ± 5%	701003-332	1	R10
Resistor, 18K, 1/4W, ± 5%	701003-183	1	R11
Resistor, 75 ohm, 1/4W, ± 5%	701003-750	1	R12
Resistor, 5.6K, 1/4W, ± 5%	701003-562	2	R14,R17
Resistor, 51.1 ohm, 1/2W, ± 1%	701225-1R1	2	R15,R16
Resistor, 330 ohm, 1/4W, ± 5%	701003-331	4	R18,R21,R22,R42
Resistor, 1K, 1/4W, ± 5%	701003-102	3	R19,R20,R36
Resistor, 866 ohm, 1/4W, ± 1%	701218-660	1	R25
Resistor, 10K, 1/4W, ± 5%	701003-103	1	R27
Resistor, 390 ohm, 1/4W, ± 5%	701003-391	1	R28
Resistor, 10 ohm, 1/4W, ± 5%	701003-100	2	R29,R32
Resistor, 8.2K, 1/4W, ± 5%	701003-822	2	R30,R33
Resistor, 3.9K, 1/4W, ± 5%	701003-391	1	R31
Resistor, 100 ohm, 1/4W, ± 1%	701211-000	1	R34

NOTE: WHEN ORDERING SPARE PARTS, CONTACT REMEX SPARES ORDER DESK AND REFERENCE COMPLETE MODEL AND SERIAL NUMBER OF UNIT. ALWAYS REFER TO ADDENDUM AT THE REAR OF THE MANUAL (IF APPLICABLE) FOR POSSIBLE PART NUMBER CHANGES.

Table 7-3. Printed Circuit Card Assembly, 114761-001 Control Board (Continued).

Description and Manufacturer's Part No.	REMEX Part No.	Quantity	Reference Designation
Resistor, 1M, 1/4W, ± 5%	701003-105	1	R37
Resistor, 4.7K, 1/4W, ± 5%	701003-472	1	R40
Resistor, 220 ohm, 1/4W, ± 5%	701003-221	2	R41,R43
Resistor Pak, 4.7K, REMEX Specification	701900-030	1	RP1
Resistor Pak, 4.7K, REMEX Specification	701900-029	3	RP2,RP3,RP4
Resistor Pak, 1K, REMEX Specification	701900-005	2	RP5,RP6
Resistor Pak, 22K, REMEX Specification	701900-032	1	RP7
Resistor Pak, 180 ohm, REMEX Specification	701900-033	1	RP8
Resistor Pak, 120 ohm, REMEX Specification	701900-034	1	RP9
Resistor, Variable, 50K, 1/2W, Beckman 82P	701656-503	1	R24
Resistor, Variable, 500 ohm, 1/2W, Beckman 82P	701656-501	1	R35
Socket, 14 pin, dip, AMP 640357-1	706515-154	1	12B
Test Pins, AMP 85931-6	706530-144	18	A-D,DS0-DS3,RDY
Transistor, NPN, 2N4401	704203-114	2	Q1,Q2
Transistor, PNP, 2N4403	704202-108	4	Q3-Q6
Transistor, PAK, NPN, Q2T2222	704203-122	2	1B,2B
Transistor, PAK, PNP, Q2T2905	704202-113	2	4B,7C

NOTE: WHEN ORDERING SPARE PARTS, CONTACT REMEX SPARES ORDER DESK AND REFERENCE COMPLETE MODEL AND SERIAL NUMBER OF UNIT. ALWAYS REFER TO ADDENDUM AT THE REAR OF THE MANUAL (IF APPLICABLE) FOR POSSIBLE PART NUMBER CHANGES.

Table 7-4. Printed Circuit Card Assembly, 114971-001, Motor Drive.

Description and Manufacturer's Part No.	REMEX Part No.	Quantity	Reference Designation
The following parts list was written for the E assembly and D schematic revisions. Subsequent changes are contained on a P.C. Card Change Record form contained in the addendum.			
Capacitor, 0.047 µf, 50V, Ceramic, Monolithic AVX SR205C473MAA	702131-103	1	C1
Capacitor, 3.3 µf, 50V, Electrolytic Panasonic ECE-A50Z3R3	702367-110	1	C2
Capacitor, 1000 pf, 50V, Ceramic, Monolithic AVX SR155C102MAA	702131-101	1	C3
Capacitor, 0.068 µf, 63V, Metallized Polyester Plessy 168/.068/J/100/A ± 5%	702182-006	1	C4
Capacitor 10 µf, 16V, Electrolytic Panasonic ECE-A16Z10	702367-111	3	C5,C20,C22
Capacitor, 0.47 µf, 50V, Electrolytic Panasonic ECE-A50ZR47	702367-107	1	C6
Capacitor, 2.2 µf, 50V, Electrolytic Panasonic ECE-A50Z2R2	702367-109	1	C7
Capacitor, 47 µf, 16V, Electrolytic	702367-112	1	C8
Capacitor, 100 µf, 25V, Electrolytic	702367-114	3	C10-C12
Capacitor, 22 µf, 25V, Electrolytic	702367-113	3	C13-C15
Capacitor, 1 µf, 50V, Electrolytic Panasonic ECE-A50Z1	702367-108	1	C16
Capacitor, 1500 pf, 50V, Ceramic Monolithic AVX SR155C152MAA	702131-102	1	C17
Capacitor 0.1 µf, 50V, Ceramic, Monolithic	702131-104	1	C21
Choke, 150 µH, ± 5%, West-Cap, DINK-150	702500-126	1	L1
Diode, 1N751A	704000-116	1	CR1
Diode, 1N4148	704000-112	3	CR2-CR4
Harness Assembly	114966-002	1	P8
Harness Assembly	114967-002	1	P3B
I.C. Package M51970L	704520-164	1	Z1
I.C. Package LM358	704520-163	1	Z2
Resistor, 270K, 1/4W, ± 5%	701003-274	1	R1
Resistor, 3.3K, 1/4W, ± 5%	701003-332	1	R3
Resistor, 200K, 1/4W, ± 5%	701003-204	1	R4

NOTE: WHEN ORDERING SPARE PARTS, CONTACT REMEX SPARES ORDER DESK AND REFERENCE COMPLETE MODEL AND SERIAL NUMBER OF UNIT. ALWAYS REFER TO ADDENDUM AT THE REAR OF THE MANUAL (IF APPLICABLE) FOR POSSIBLE PART NUMBER CHANGES.

Table 7-4. Printed Circuit Card Assembly, 114971-001, Motor Drive (Continued).

Description and Manufacturer's Part No.	REMEX Part No.	Quantity	Reference Designation
Resistor, 180 ohm, 1W, ± 5%	701005-181	1	R5
Resistor, 47 ohm, 1/4W, ± 5%	701003-470	1	R6
Resistor, 8.2K, 1/4W, ± 5%	701003-822	1	R7
Resistor, 10K, 1/4W, ± 5%	701003-103	6	R8,R9,R12,R27, R28,R29
Resistor, 1K, 1/4W, ± 5%	701003-102	1	R11
Resistor 33.2K, 1/8W, ± 1%	701203-322	1	R13
Resistor, 150 ohm, 1/4W, ± 5%	701003-151	6	R15-R20
Resistor, 390K, 1/4W, ± 5%	701003-394	3	R21-R23
Resistor, 15 ohm, 1/4W, ± 5%	701003-150	3	R24-R26
Resistor, 100 ohm, 1/4W, ± 5%	701003-101	1	R32
Resistor, Variable, 20K, 1/2W	701658-203	1	R30
Transistor, MJE210	704212-118	1	Q1
Transistor, 2N6714	704204-135	3	Q2-Q4
Transistor, 2N6727	704212-117	3	Q5-Q7
Transistor, 2N4401	704203-114	5	Q8-Q12

NOTE: WHEN ORDERING SPARE PARTS, CONTACT REMEX SPARES ORDER DESK AND REFERENCE COMPLETE MODEL AND SERIAL NUMBER OF UNIT. ALWAYS REFER TO ADDENDUM AT THE REAR OF THE MANUAL (IF APPLICABLE) FOR POSSIBLE PART NUMBER CHANGES.

Table 7-5. Printed Circuit Card Assembly, 114861-001 Control Board.

Description and Manufacturer's Part No.	REMEX Part No.	Quantity	Reference Designation
The following parts list was written for the F assembly and the D schematic revisions. Subsequent changes are contained on the P.C. Card Change Record or contained in the addendum.			
Capacitor, 0.1 µf, 50V, Ceramic West-Cap Z512BZ104Z	702141-106	11	C1,8,10,11,13,15, 23,25,27,30,35
Capacitor,1000 pf, 50V, Ceramic West-Cap X512BY102J	702141-103	2	C2,C16
Capacitor, 0.0047 µf, 50V, Ceramic West-Cap DG46BY472J	702131-109	1	C3
Capacitor, 22 µf, 25V, Electrolytic, Illinois Capacitor 224TTA025A	702641-226	9	C4-C7,C9,C12, C18,C19,C26
Capacitor, 510 pf, 100V, Dipped Mica Cornell-Dubilier FA511JGF103	702123-511	1	C14
Capacitor, 100 pf, 50V, Ceramic West-Cap X511BY101	702141-101	1	C21
Capacitor, 390 pf, 100V, Ceramic West-Cap X511BY391J	702141-115	1	C22
Capacitor, 0.22 µf, 50V, Ceramic, Monolithic, AVX 5R305C224KAA	702131-108	1	C24
Capacitor, 0.015 µf, 50V, Ceramic, West-Cap W511BX153K	702141-114	1	C28
Capacitor, 2.2 µf, 35V, Solid-Tantalum Sprague 196D105X9035HA1	702396-225	1	C29
Choke, 33 µH, West-Cap DINK-33	702500-125	1	L1
Choke, 82 µH, West-Cap DINK-82	702500-122	2	L2,L3
Choke, 330 µH, West-Cap DINK-330	702500-130	2	L4,L5
Choke, 150 µH, West-Cap DINK-150	702500-126	3	L6,L7,L8
Connector, 4 pin, Right Angle Amp 641737-1	706500-357	1	J2
Connector, 18 pin, Right Angle Amp 65626-114	706500-364	1	J3
Connector, 8 pin, Right Angle Berg 65626-108	706500-365	1	J4
Connector, 6 pin, Right Angle Amp 65592-106	706500-361	2	J5,J6

NOTE: WHEN ORDERING SPARE PARTS, CONTACT REMEX SPARES ORDER DESK AND REFERENCE COMPLETE MODEL AND SERIAL NUMBER OF UNIT. ALWAYS REFER TO ADDENDUM AT THE REAR OF THE MANUAL (IF APPLICABLE) FOR POSSIBLE PART NUMBER CHANGES.

Table 7-5. Printed Circuit Card Assembly, 114861-001 Control Board (Continued).

Description and Manufacturer's Part No.	REMEX Part No.	Quantity	Reference Designation
Connector, 2 Contact, Amp 531220-2	706510-361	4	(DS0-DS3, A-D, RDY)
Diode, 1N4148	704000-112	26	CR1-CR26
Diode, Zener, 3.3V, 1N5226B	704010-129	1	VR1
I.C. Package, 74LS86	704620-086	1	2A
I.C. Package, 74LS74	704620-074	2	3A,4A
I.C. Package, 96LS02	704621-004	2	5A,5B
I.C. Package, 74LS10	704620-010	1	6A
I.C. Package, LM339	704520-156	1	8A
I.C. Package, 74LS27	704900-110	1	2B
I.C. Package, 74LS27	704620-027	1	7B
I.C. Package, 1CL7660	704520-158	1	8B
I.C. Package, 74LS00	704620-000	1	9B
I.C. Package, 7414	704600-150	1	10B
I.C. Package, 74LS14			
I.C. Package, 7438	704600-149	1	13B
I.C. Package, 7426	704600-151	2	3C,4C
I.C. Package, MC3470	704810-148	1	5D
I.C. Package, 7406	704600-111	1	3B
I.C. Package, DG211	704810-147	1	7D
I.C. Package, Resistor 47K	701900-031	1	7A
I.C. Package, Resistor 220/330 ohm	701900-011	1	12B
LED, General Instrument MV5021	704004-006	1	DS1
Resistor, 787K, 1/4W, ± 1%	701217-873	1	R5
Resistor, 511K, 1/4W, ± 1%	701215-113	1	R6
Resistor, 100 ohm, 1/4W, ± 5%	701003-101	4	R7,R8,R38,R39
Resistor, 2.2K, 1/4W, ± 5%	701003-222	1	R9
Resistor, 3.3K, 1/4W, ± 5%	701003-332	1	R10
Resistor, 18K, 1/4W, ± 5%	701003-183	1	R11
Resistor, 75 ohm, 1/4W, ± 5%	701003-750	1	R12
Resistor, 470 ohm, 1/4W, ± 5%	701003-471	2	R13,R23
Resistor, 5.6K, 1/4W, ± 5%	701003-562	2	R14,R17

NOTE: WHEN ORDERING SPARE PARTS, CONTACT REMEX SPARES ORDER DESK AND REFERENCE COMPLETE MODEL AND SERIAL NUMBER OF UNIT. ALWAYS REFER TO ADDENDUM AT THE REAR OF THE MANUAL (IF APPLICABLE) FOR POSSIBLE PART NUMBER CHANGES.

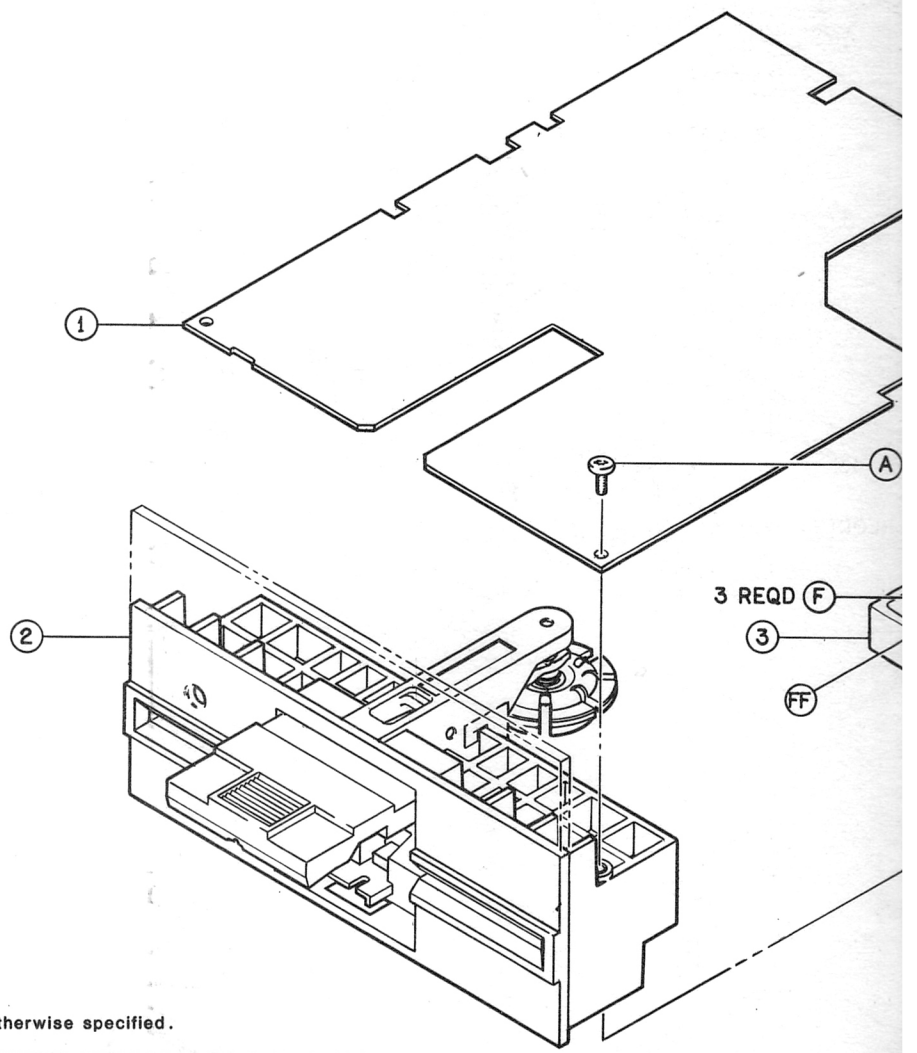
Table 7-5. Printed Circuit Card Assembly, 114861-001 Control Board (Continued).

Description and Manufacturer's Part No.	REMEX Part No.	Quantity	Reference Designation
Resistor, 51.1 ohm, 1/2W, ± 1%	701225-1R1	2	R15,R16
Resistor, 330 ohm, 1/4W, ± 5%	701003-331	4	R18,R21,R22,R42
Resistor, 1K, 1/4W, ± 5%	701003-102	3	R19,R20,R36
Resistor, 820 ohm, 1/4W, ± 5%	701003-821	1	R25
Resistor, 10K, 1/4W, ± 5%	701003-103	1	R27
Resistor, 390 ohm, 1/4W, ± 5%	701003-391	1	R28
Resistor, 8.2K, 1/4W, ± 5%	701003-822	2	R30,R33
Resistor, 3.9K, 1/4W, ± 5%	701003-392	1	R31
Resistor, 100 ohm, 1/4W, ± 1%	701211-000	1	R34
Resistor, 1M, 1/4W, ± 5%	701003-105	1	R37
Resistor, 4.7K, 1/4W, ± 5%	701003-472	2	R40,R44
Resistor, 220 ohm, 1/4W, ± 5%	701003-221	1	R41
Resistor, 150 ohm, 1/4W, ± 5%	701003-151	1	R43
Resistor, 715K, 1/4W, ± 1%	701217-153	1	R45
Resistor, 2.2K, 1/4W, ± 5%	701003-222	1	R46
Resistor Pak, 4.7K, REMEX Specification	701900-029	1	RP2
Resistor Pak, 2.2K, REMEX Specification	701900-037	1	RP3
Resistor Pak, 390 ohm, REMEX Specification	701900-036	1	RP4
Resistor Pak, 1K, REMEX Specification	701900-005	2	RP5,RP6
Resistor Pak, 22K, REMEX Specification	701900-032	1	RP7
Resistor Pak, 180 ohm, REMEX Specification	701900-033	1	RP8
Resistor Pak, 120 ohm, REMEX Specification	701900-034	1	RP9
Resistor, Variable, 50K, 1/2W, Beckman 82P	701656-503	1	R24
Resistor, Variable, 500 ohm, 1/2W, Beckman 82P	701656-501	1	R35
Socket, 14 pin, dip, AMP	706515-148	1	12B
Test Pins, AMP 85931-6	706530-144	18	A-D,DS0-DS3,RDY
Transistor, NPN, 2N4401	704203-114	3	Q1,Q2,Q7
Transistor, PNP, 2N4403	704202-108	4	Q3-Q6
Transistor, 2N6726	704202-114	4	Q8-Q11
Transistor, PAK, PNP, Q2T2905	704202-113	1	7C

P.C. CARD CHANGE RECORD

CARD ASSY NO. 114861-001
SCHEMATIC NO. 114862

SCH REV	ASSY REV	FAB REV	DESCRIPTION OF CHANGE
D	G	A	No component or circuit change.
E	H	A	Change C29 to 2.2 µf, 35V, REMEX P/N 702396-225.



NOTES: unless otherwise specified.

(1) SENSOR ORIENTED WITH DOT MARKER AS SHOWN.

MMC 756A

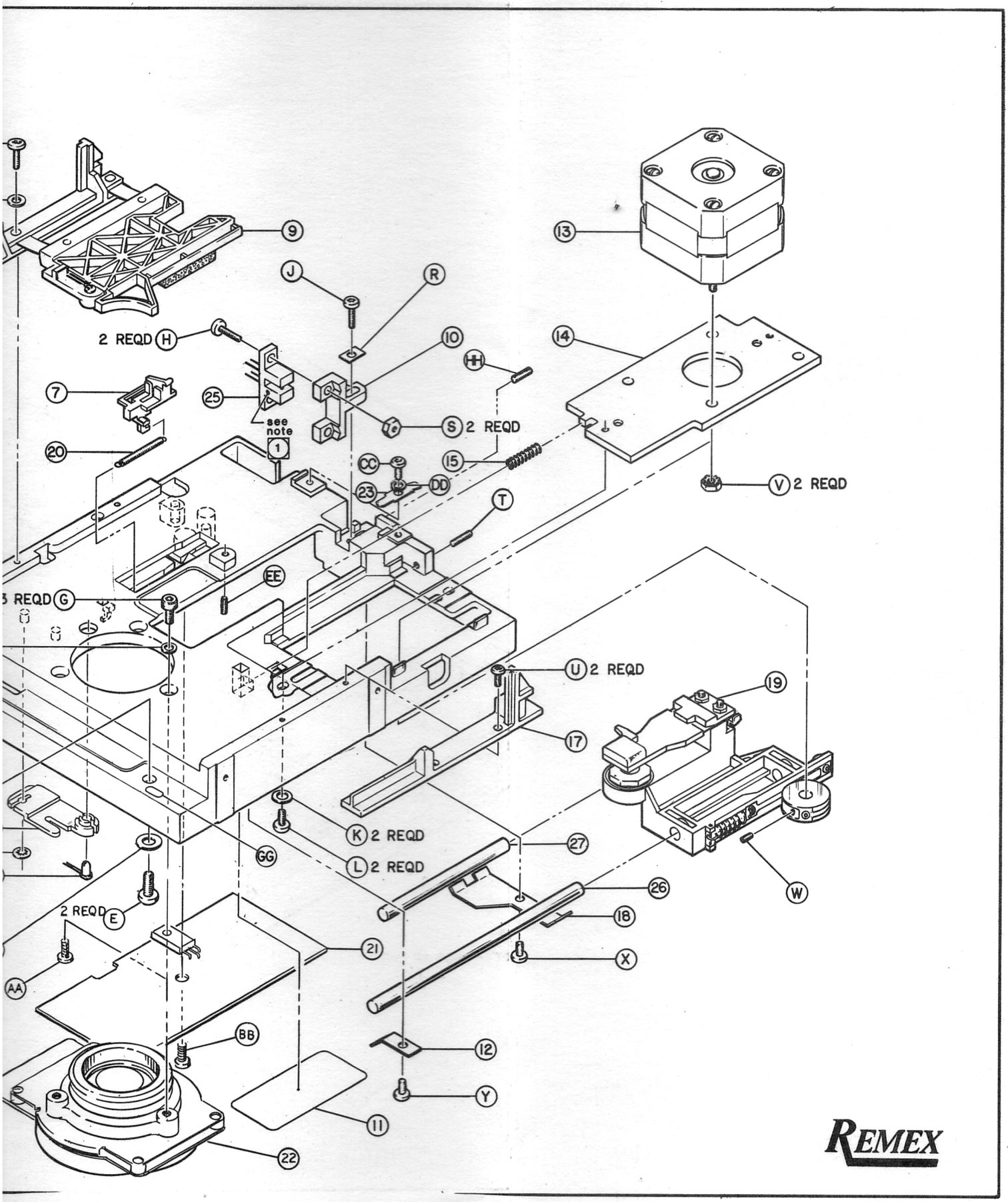


Figure 7-1. Exploded Drawing of RFD480 and RFD960.

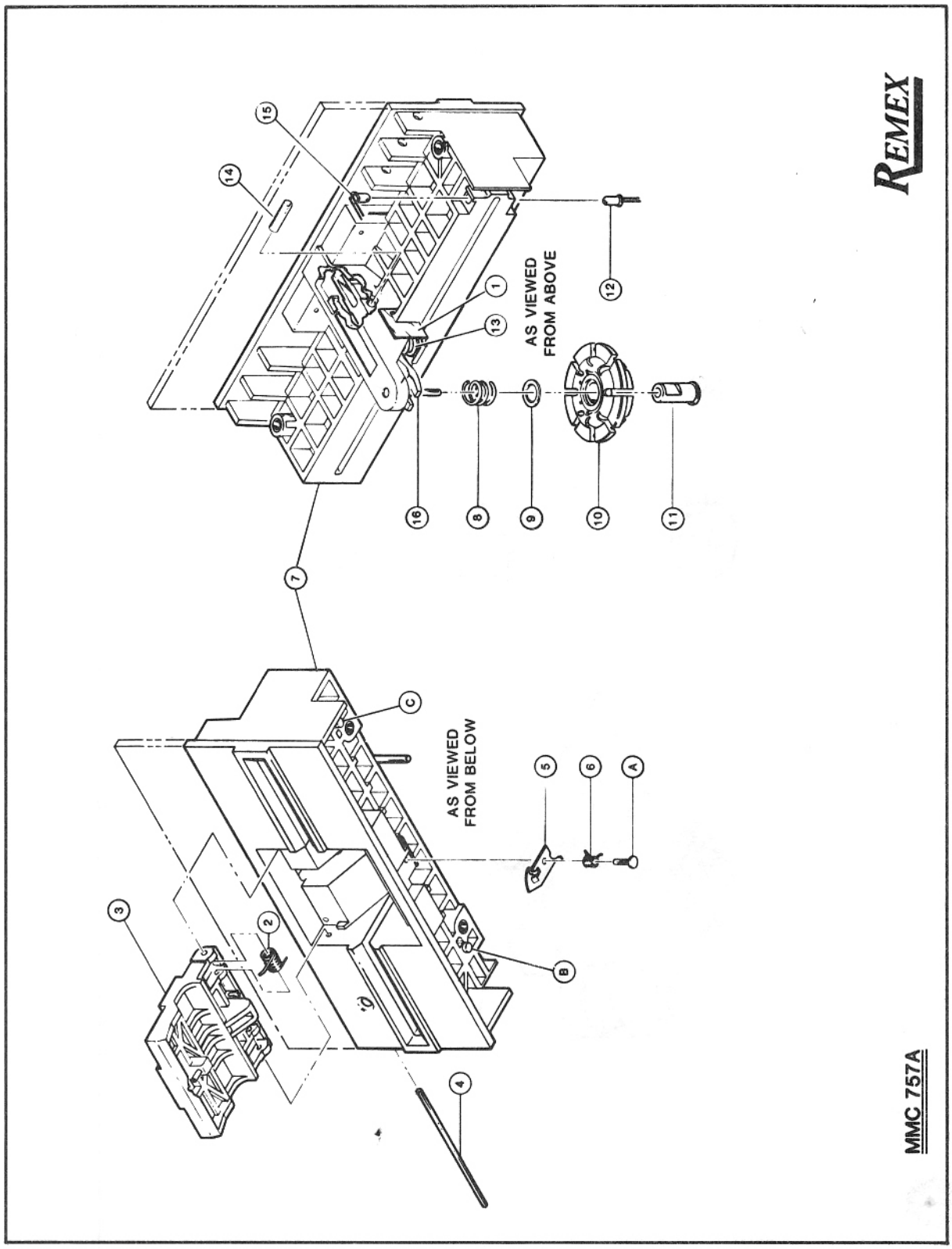


Figure 7-2. Exploded Drawing of Front Bezel/Clutch Assembly.

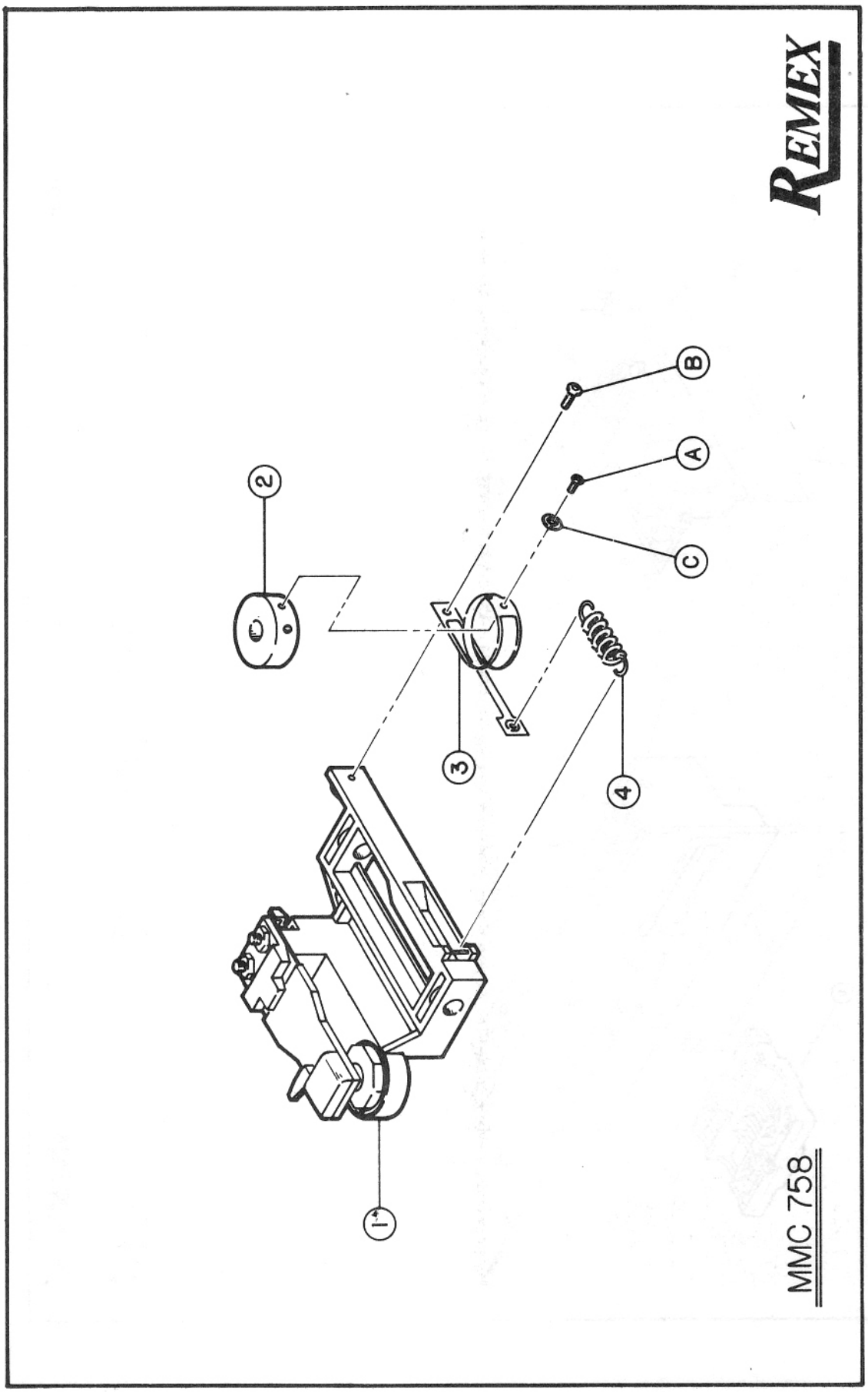


Figure 7-3. Exploded Drawing, Carriage Assembly.

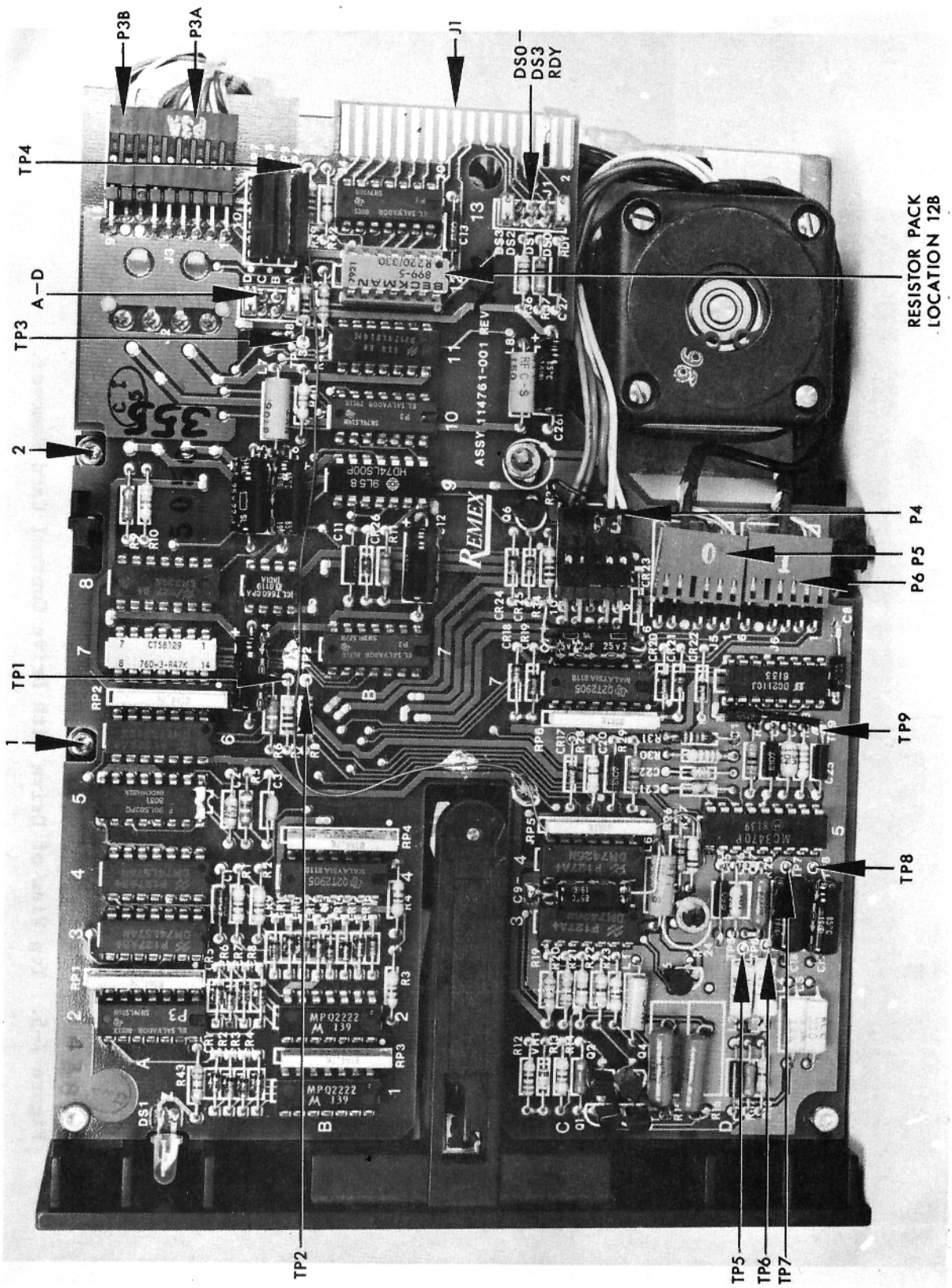


Figure 7-4. Top View of Drive Showing P.C. Card 114761-001.

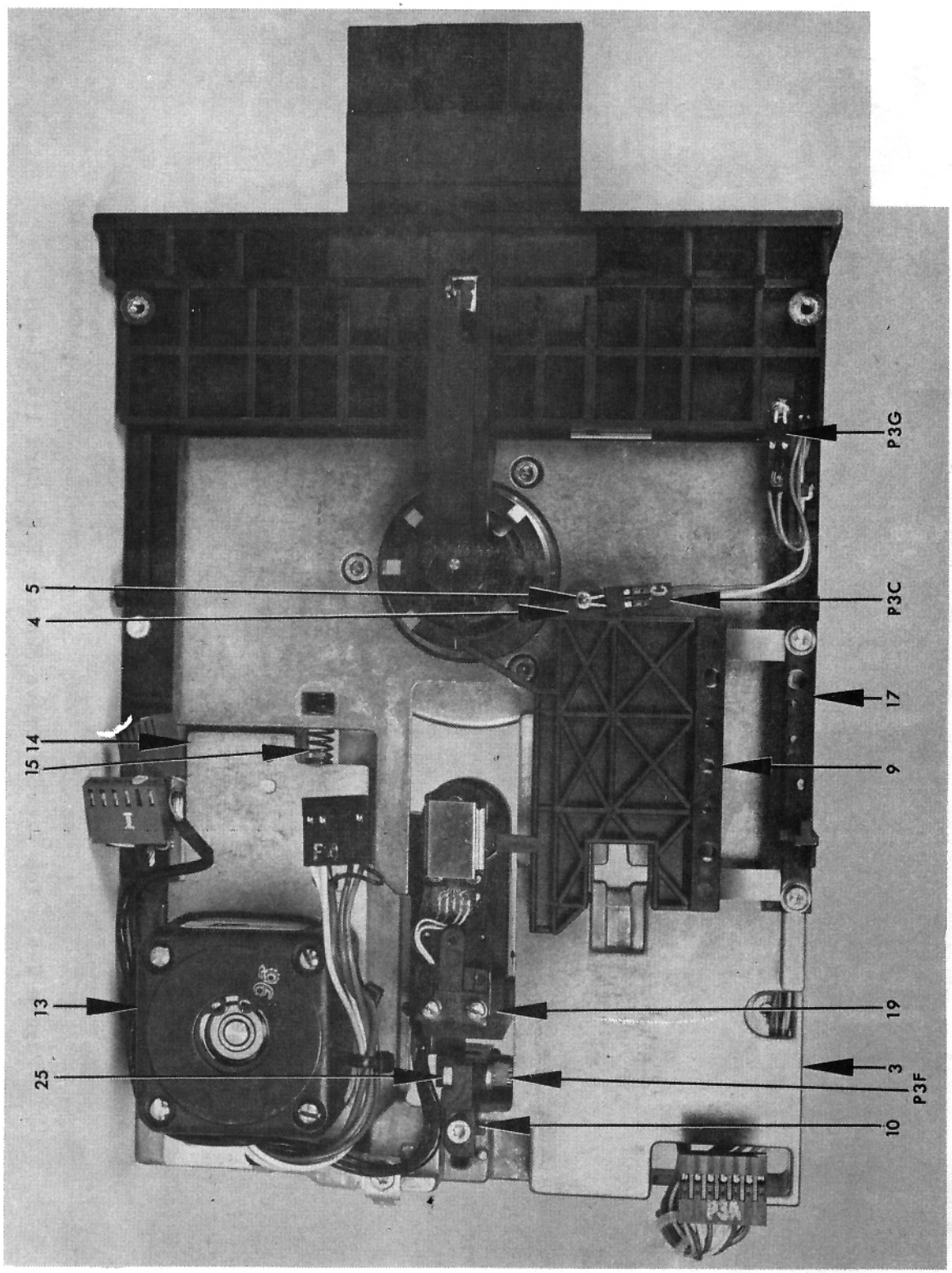


Figure 7-5. Top View of Drive with Drive Control Card Removed.

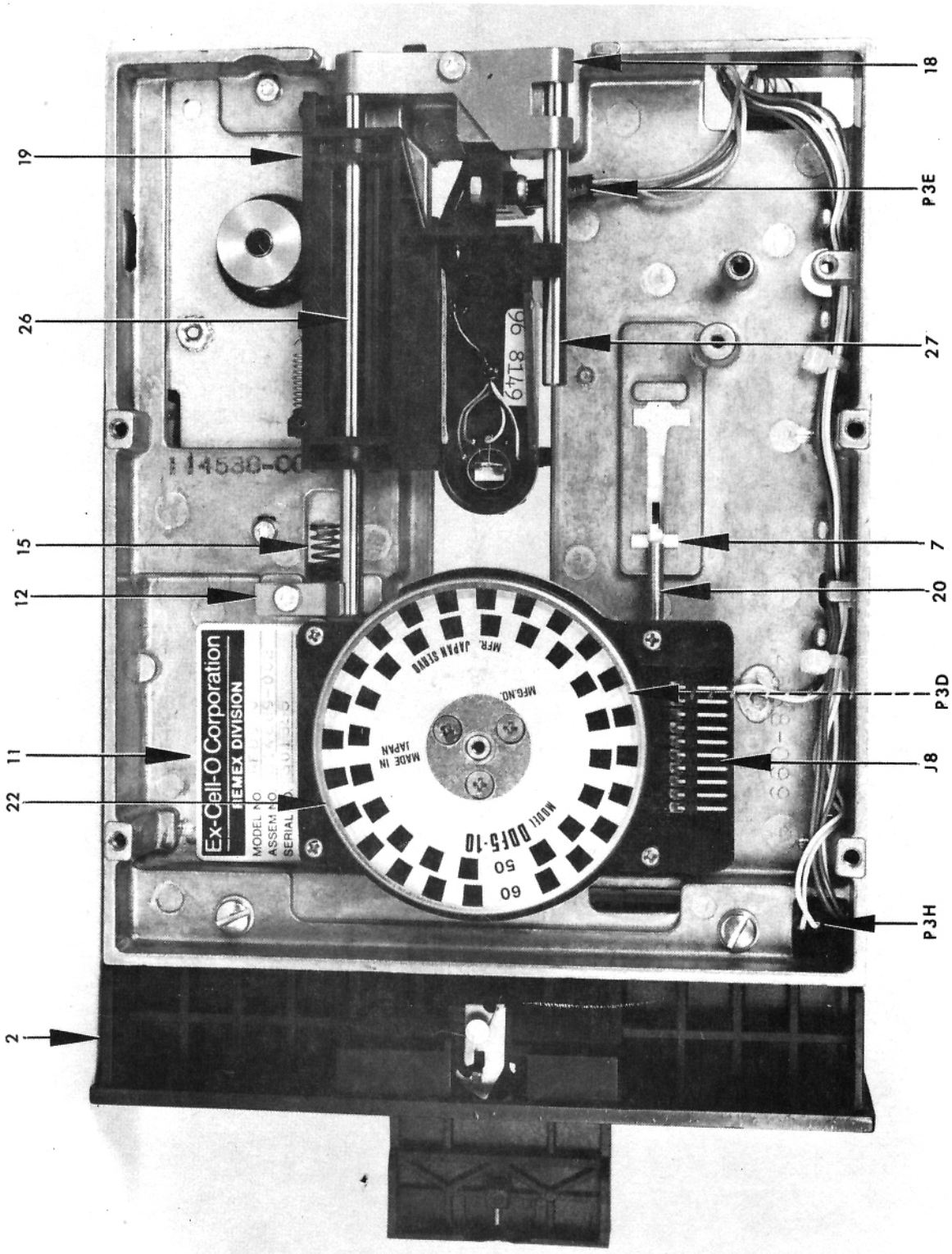


Figure 7-6. Bottom View of Drive with Motor Control Card Removed.

SECTION VIII

SCHEMATIC DRAWINGS

8.1 GENERAL

The following schematics comprise Section VIII:

Figure 8-1. System Schematic.

Figure 8-2. Schematic Control Board 114761-001.

Figure 8-3. Schematic, Motor Drive Card 114971-001.

Figure 8-4. Schematic, Control Card 114861-001.

NOTES: UNLESS OTHERWISE SPECIFIED.

1. Q101 & Q102 IS SDP8405-3.
2. CR101 & CR102 IS SEP8505-3.
3. ØS101 IS SPX-1879-15. (OPTO SWITCH)

SYM	ECO	EFFECT.	REVISIONS	BY	DATE	APPRD
X1	20017	[illegible]	RELEASED	OD	7.27.81	JKY
X2	20028	[illegible]	SEE ECO	EDS	7.31.81	JKY
X3	20035	[illegible]	SEE ECO	EDS	12.3.81	JKY
X4	20051	[illegible]	SEE ECO	SEO	2.15.82	JKY
X5	20088	[illegible]	SEE ECO	SEO	6.25.82	JKY
A	20072	8.15.82	SEE ECO	SEO	8.13.82	JKY

J1

- 8 INDEX/SECTOR *
- 10 DRIVE SELECT Ø *
- 12 DRIVE SELECT 1 *
- 14 DRIVE SELECT 2 *
- 16 DRIVE SELECT 3 *
- 18 DIRECTION IN *
- 20 STEP *
- 22 WRITE DATA *
- 24 WRITE GATE *
- 26 TRACK Ø *
- 28 WRITE CONTROL *
- 30 READ DATA
- 32 SIDE SELECT *
- 2, 4, 34 } N/C
- 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33 } ØV

CONTROL BOARD ASSY 114861-*
SCHEMATIC 114862-001

PART OF J3

P3B
- 10 N/C
- 20 N/C
- 30 17 MOTOR ON
- 40 18 POWER GND
- 9 +12V
- KEY 1 8 KEY

HARNESS ASSY Nº 114967-002

J2
- 1 +12V
- 2 GND
- 3 GND
- 4 +5V

J8 P8 — M102 BRUSHLESS MOTOR

HARNESS ASSY Nº 114966-002

BRUSHLESS MOTOR DRIVE CARD ASSY 114971-001 SCHEMATIC 114972-001

J4 P4
- 5 N/C
- 2 N/C
- 6 N/C
- KEY 1 KEY
- 7 BLU — PHASE 1 — RED 8
- 3 WHT — PHASE 2 — YEL 4

M101 STEPPER MOTOR (3.6°)

P4 (alternate)
- 6 N/C
- 5 N/C
- 2 N/C
- 7 BLU
- 6 RED
- 3 WHT
- 4 YEL
- 1 KEY

M101 STEPPER MOTOR (1.8°)

HARNESS ASSY NR. 114936-001

J3 P3A
- 15 13 W/BRN
- 14 12 YEL — P3C — Q101 — [1]
- 5 5 GRN
- 6 6 W/RED — P3D — [2] CR101 — INDEX/SECTOR *

P3D
- 10 8 BRN
- 1 1 RED
- 11 9 GRY
- 2 2 WHT

P3E — TRACK ØØ * — [3] ØS101 — P3F

P3H
- 13 11 W/ORN
- 12 10 BLU — P3G — Q102 — [1]
- 3 3 VIO — [2] CR102 — WRITE CONTROL *
- 4 4 W/YEL — P3H
- KEY 7 7 KEY
- 16 14 N/C

J5 P5(Ø)
- 1 WHT
- 2 YEL — R/W HEAD Ø
- 3 BLK
- BLU
- KEY 4
- 6 RED — ERASE HEAD Ø
- 5 SHIELD

ASSY OF - DOUBLE SIDED HEAD CARRIAGE 114738-*

J6 P6(1)
- 1 WHT
- 2 YEL — R/W HEAD 1
- 3 BLK
- BLU
- KEY 5
- 6 RED — ERASE HEAD 1
- 4 SHIELD

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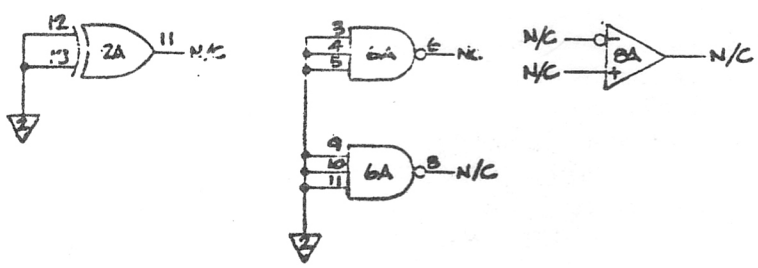
Figure 8-1. System Schematic.
112670-122D 8-3/8-4

SIGNAL INDEX			
SIGNAL	DESCRIPTION	SOURCE	ADDRESS
HD OUTPUT A			3B3, 4D8
HD OUTPUT B			3B3, 4C8
MOTOR ON		5A8	5A4
OUT ENABLE		2C5	3B8, 4C3, 5A7, 5D7
PHASE A*			2B4, 5C7
PHASE B*			2B4, 5D7
PWRON RST*		2D5	3A6, 3D6
SIDE SEL		2D7	3C8
W DATA		2E7	3D8
N GATE		2D7	3B8

DESCRIPTION	LAST REF DES. USED	REF. DES NOT USED
I.C.	13B	
CHOKE	L8	
CONNECTOR	J6	
RESISTOR PAK	RP9	
DIODE	CR16	
CAPACITOR	C17	
RESISTOR	R43	
L.E.D	DS1	
TRANSISTOR	Q6	
TEST POINT	TP9	
ZENER DIODE	VR1	

SPARES



REVISION STATUS		
FAB.	SCHEM.	ASSY
X1	X1	—
X2	X1	X1
X3	X2	X2
X3	X3	X3
X3	X4	X4
X3	X5	X5
X3	X5	X6
X5	X6	X7
X5	X6	X8
X5	X6	X9
X5	X7	X10
X5	X7	X11
X5	X7	X12
X5	X8	X13
X5	X9	X14
X5	X10	X15

PICO
USED

SYM	ECO	EFFECT.	REVISIONS	BY	DATE	APPRD
X7	20223	12.16.82	R31 WAS 16K, IS 3.9K	EDS	12.16.82	VKV
X8	20287	1.22.83	C22 WAS 50V	VKV	1.22.83	VKV
X9	20320	2.3.83	REV STATUS UPDATE, SEE ECO	DGM	2.3.83	VKV
X10	20405	4.28.83	G/N 26 WAS 704520-158 ECL 74L	DGM	4.28.83	VKV

NOTES: UNLESS OTHERWISE SPECIFIED:

1. THE THREE CHARACTER SOURCE/ADDRESS IS AS FOLLOWS: SHEET NO VERTICAL ZONE AND HORIZONTAL ZONE.
2. INDUCTOR VALUES ARE IN MICROHENRIES ± 5%.
3. CAPACITOR VALUES ARE IN MICROFARADS, +80%, -10% 50V.
4. RESISTOR VALUES ARE IN OHMS, ±5%, 1/4 WATT.
5. CR1 THRU CR26 ARE 704000-112 (1N4148).
6. 12B IS 701900-011 (RESISTOR PAK - 220/330Ω).
7. RP2, RP3, RP6 ARE 701900-029 (RESISTOR PAK 4.7K).
8. RP5 RP6 ARE 701900-005 (RESISTOR PAK-1K).
9. RP8 IS 701900-035 (RESISTOR PAK - 22K).
10. RP9 IS 701900-003 (RESISTOR PAK - 180Ω).
11. RP10 IS 701900-034 (RESISTOR PAK - 120Ω).
12. 7A IS 701900-031 (RESISTOR PAK - 47K).
13. 1B, 2B ARE 704203-122 (Q2T2222).
14. 4B, 7C ARE 704202-113 (Q2T2905).
15. 9B, IS 704620-000 (74LS00).
16. 11B, IS 704620-04 (74LS14).
17. 7B IS 704620-027 (74-627).
18. 3C, 4C, ARE 704600-151 (7426).
19. 13B IS 704600-149 (7438).
20. 3A, 4A, ARE 704620-074 (74L674).
21. 2A IS 704620-086 (74L686).
22. 5A IS 704621-004 (9LL600Ø2).
23. 8A IS 704520-156 (LM339).
24. 7D IS 704810-147 (DG211).
25. 5D IS 704810-148 (MC3470).
26. 8B IS 704810-150 (ICL7660).
27. 6A IS 704620-010 (74L61Ø).
28. 10B IS 704600-150 (7414)

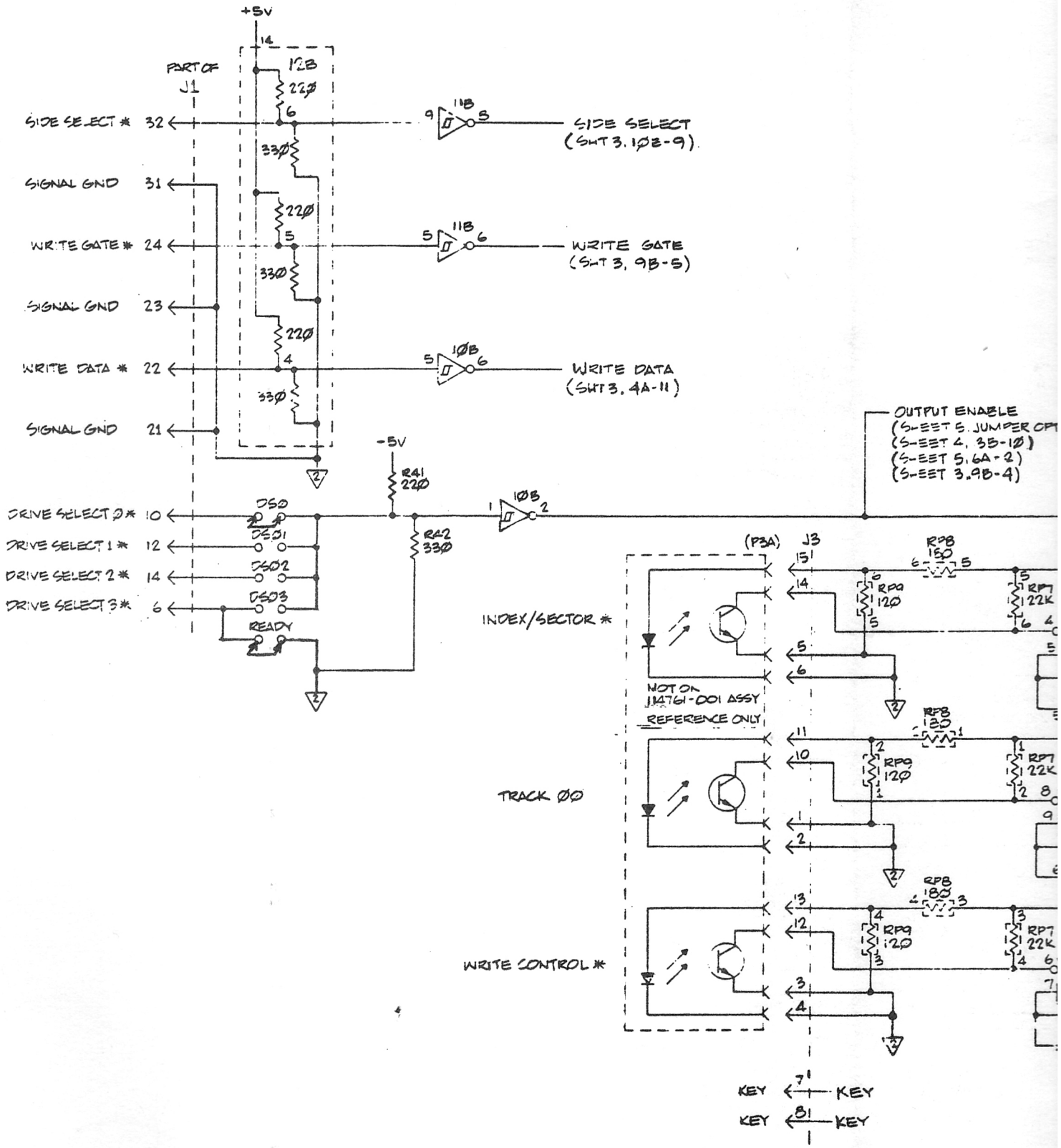
NOTE NO	POWER/GROUND PIN ASSIGNMENTS						
	-5V	+5V	+5VF	+12V	-12VF	▽1	▽2
15.		14					7
16.		14					7
17.		14					7
18.		14					7
19.		14					7
20.		14					7
21.		14					7
22.		16					8
23.					3		12
24.	4		12		13	5	
25.						5	
26.	5	8				5	
27.		14					7
28		14					7

REF. DES. NOT USED

ASSY
—
X1
X2
X3
X4
X5
X6
X7
X8
X9
X10
X11
X12
X13
14
15

MCO	114761-001
USED ON	NEXT ASSY

Figure 8-2. Schematic Control Board, 114761-001
112670-122B Sheet 1 of 5 8-5/8-6


+5V
PART OF J1
12B
220
SIDE SELECT * 32
SIGNAL GND 31
WRITE GATE * 24
SIGNAL GND 23
WRITE DATA * 22
SIGNAL GND 21
330
11B
SIDE SELECT (SHT 3, 10E-9)
WRITE GATE (SHT 3, 9B-5)
10B
WRITE DATA (SHT 3, 4A-11)
-5V
R41 220
R42 330
DRIVE SELECT 0 * 10
DRIVE SELECT 1 * 12
DRIVE SELECT 2 * 14
DRIVE SELECT 3 * 6
DS0
DS01
DS02
DS03
READY
OUTPUT ENABLE
(SHEET 5, JUMPER CP
(SHEET 4, 3B-10)
(SHEET 5, 6A-2)
(SHEET 3, 9B-4)
(P3A) J3
INDEX/SECTOR *
TRACK 00
WRITE CONTROL *
NOT ON 114761-001 ASSY
REFERENCE ONLY
RP8 150
RP8 120
RP8 130
RP8 180
RP9 120
RP7 22K
KEY 7 KEY
KEY 8 KEY

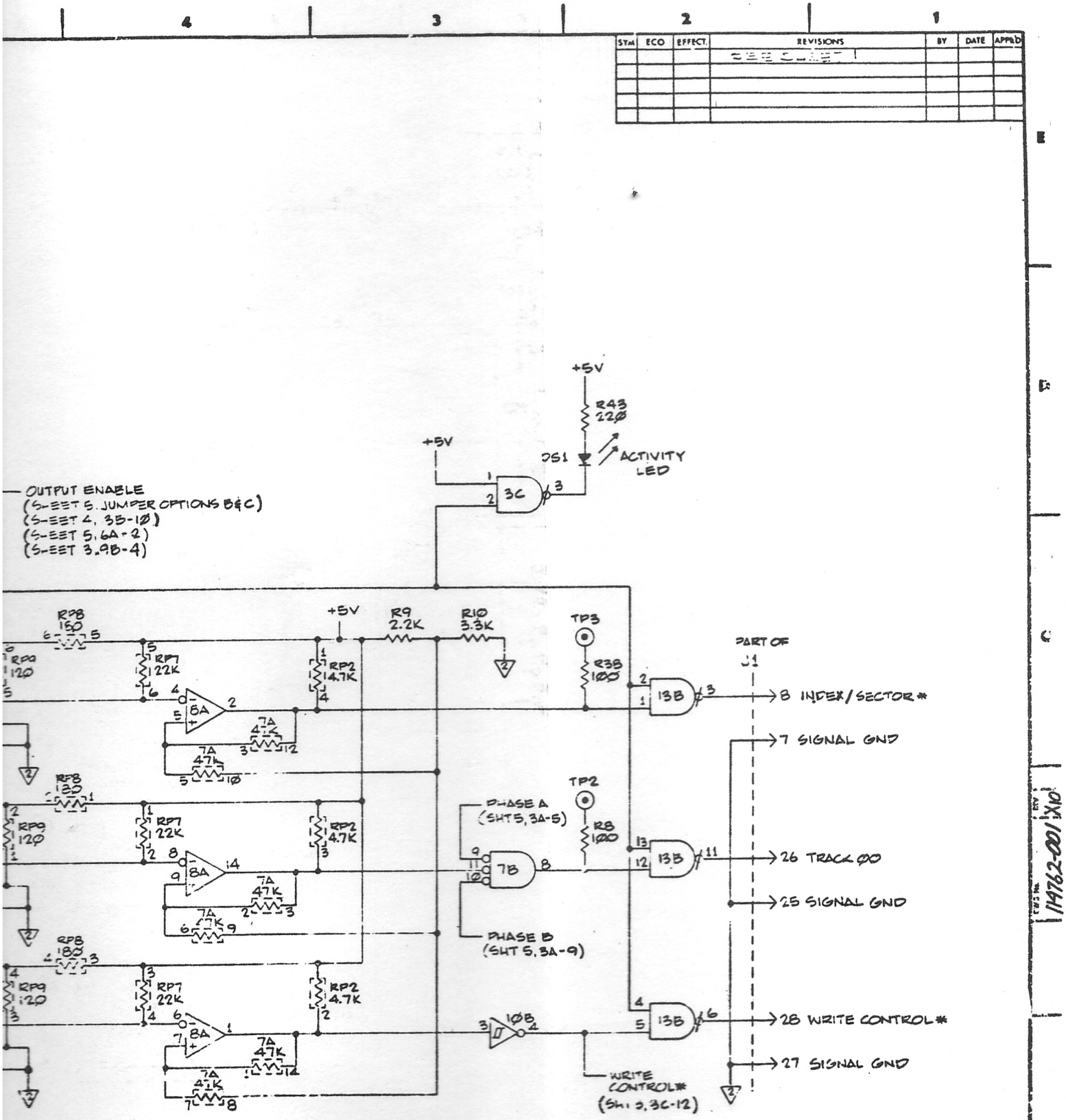
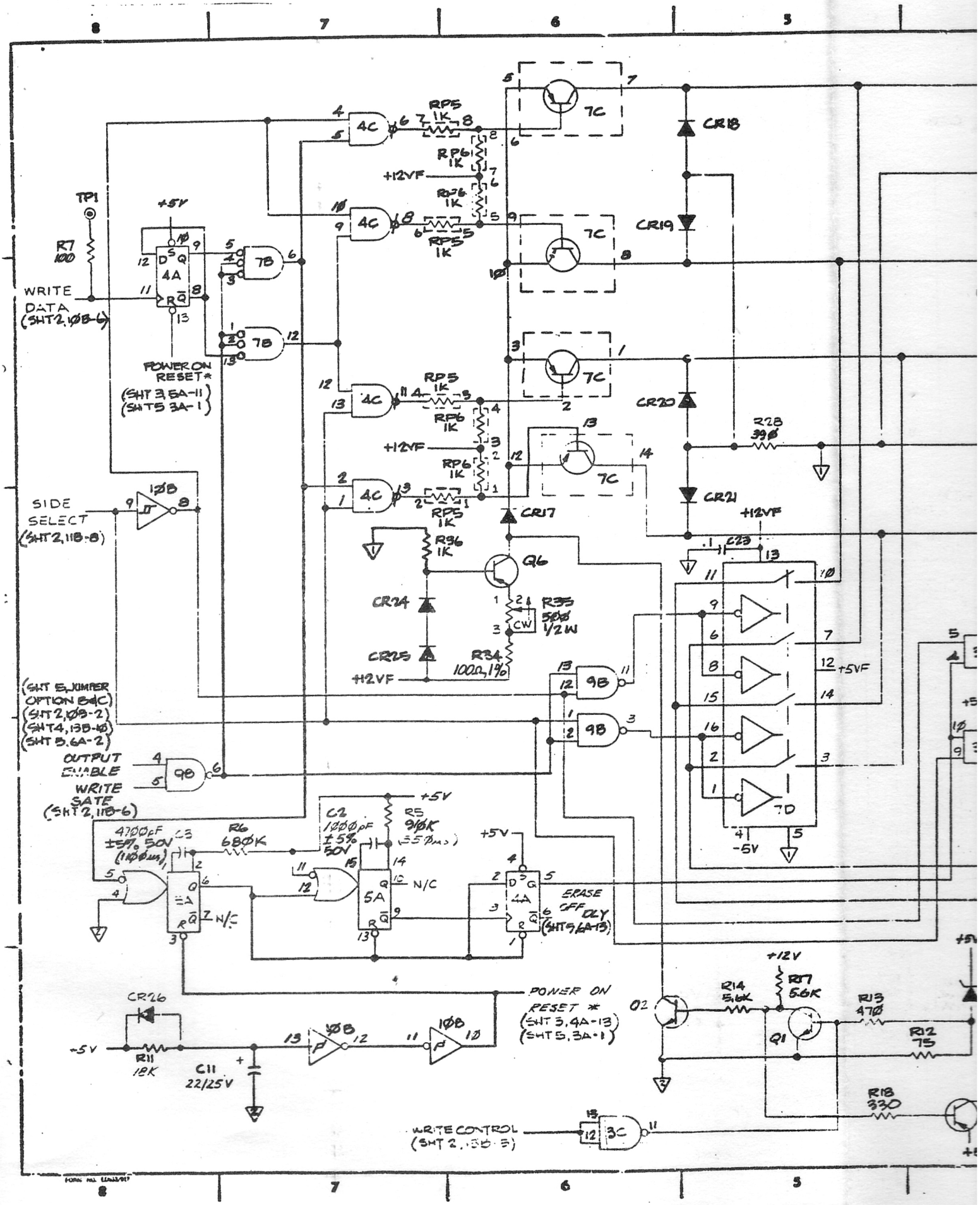


Figure 8-2. Schematic Control Board, 114761-001
112670-122B Sheet 2 of 5 8-7/8-8


TP1
R7 100
WRITE DATA (SHT 2, 10B-6)
+5V
4A
7B
POWER ON RESET* (SHT 3, 5A-11) (SHT 5 3A-1)
4C
RP5 1K
RP6 1K
+12VF
7C
CR18
CR19
CR20
CR21
R28 39Ø
CR17
R36 1K
Q6
CR24
R35 50Ø 1/2W
CW
CR25
R34 100Ω, 1%
10B
SIDE SELECT (SHT 2, 11B-8)
9B
(SHT 5, JUMPER OPTION 54C) (SHT 2, 10B-2) (SHT 4, 13B-10) (SHT 5, 6A-2)
OUTPUT ENABLE
WRITE GATE (SHT 2, 11B-6)
C23 .1
7D
-5V
+12V
C3 4700pF ±5% 50V (1ØØµs)
R6 680K
C2 1ØØØpF ±5% 50V
R5 91ØK (35µs)
5A
N/C
ERASE OFF ONLY (SHT 5, 6A-13)
POWER ON RESET * (SHT 3, 4A-13) (SHT 5, 3A-1)
CR26
R11 18K
C11 22/25V
Q2
R14 5.6K
R17 5.6K
Q1
R13 47Ø
R12 75
R18 33Ø
WRITE CONTROL (SHT 2, 13B-5)
3C

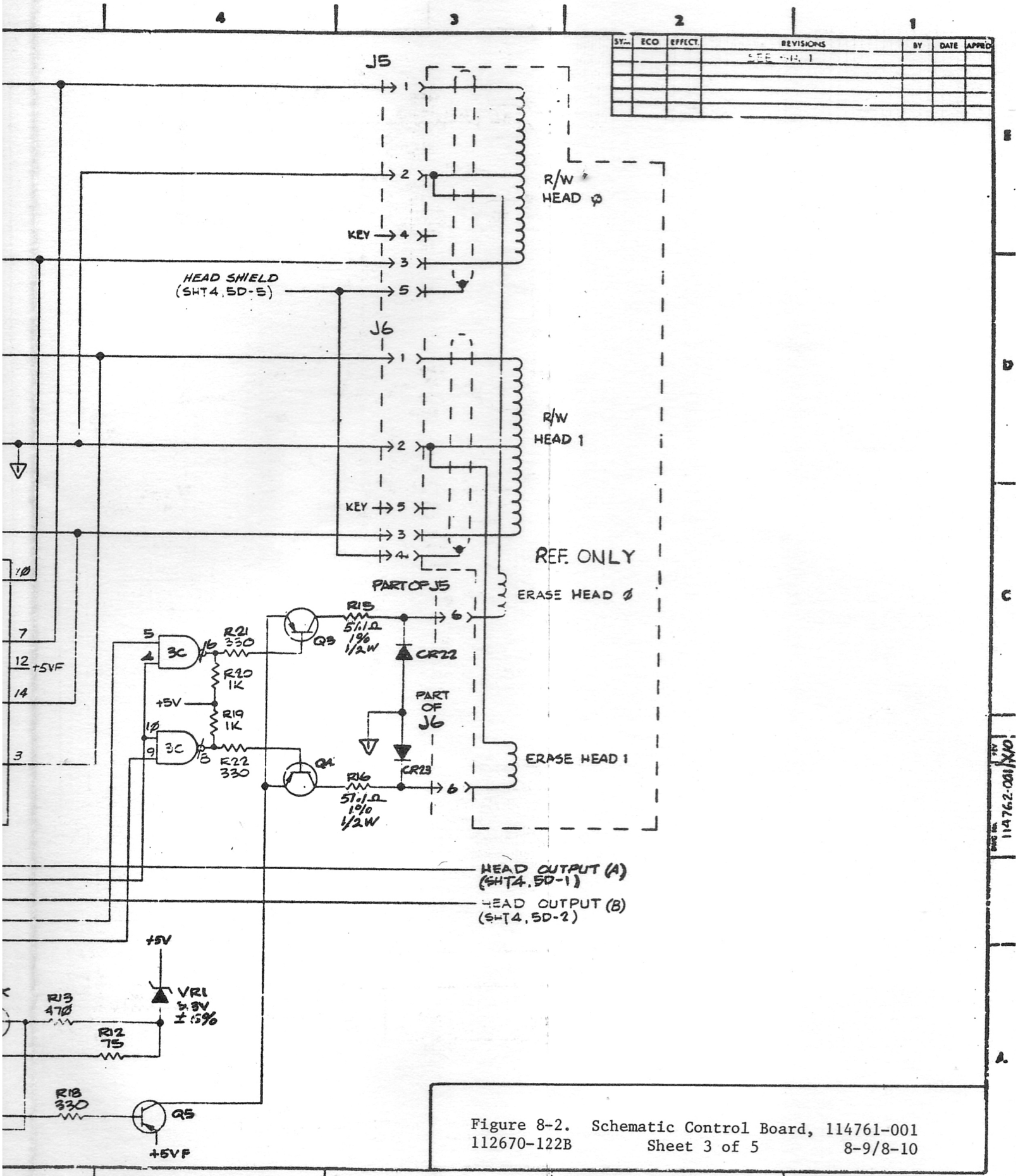
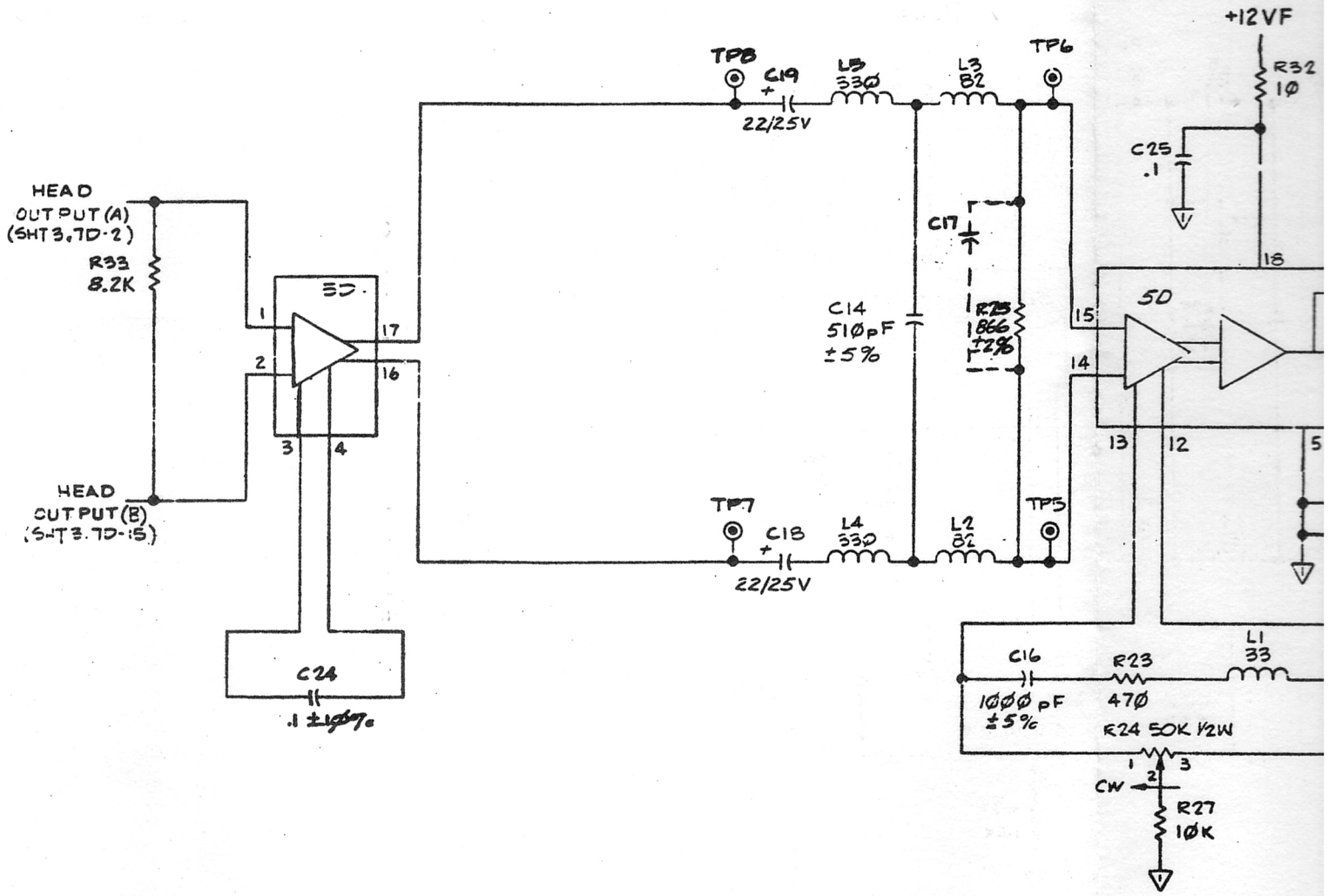
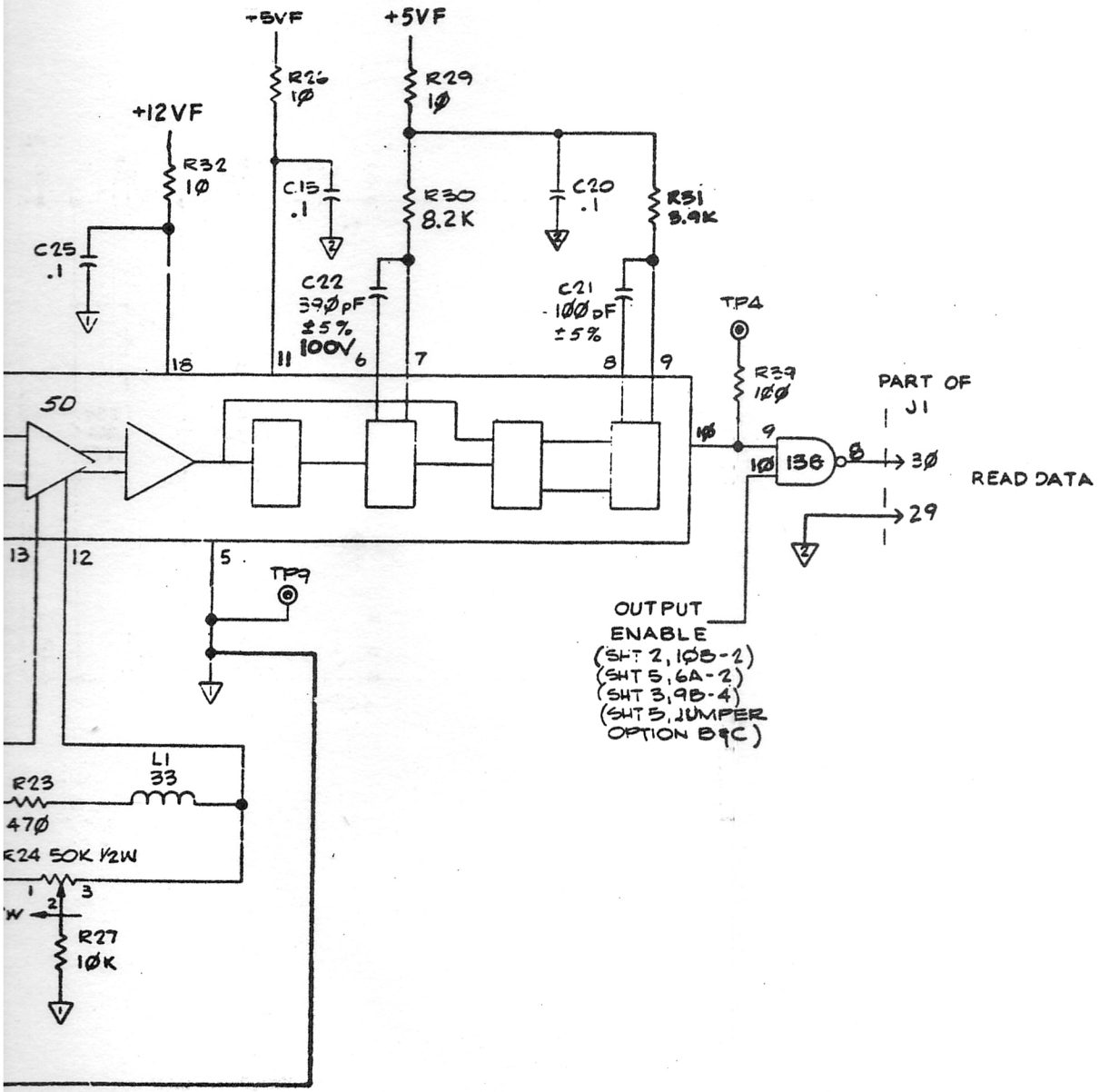


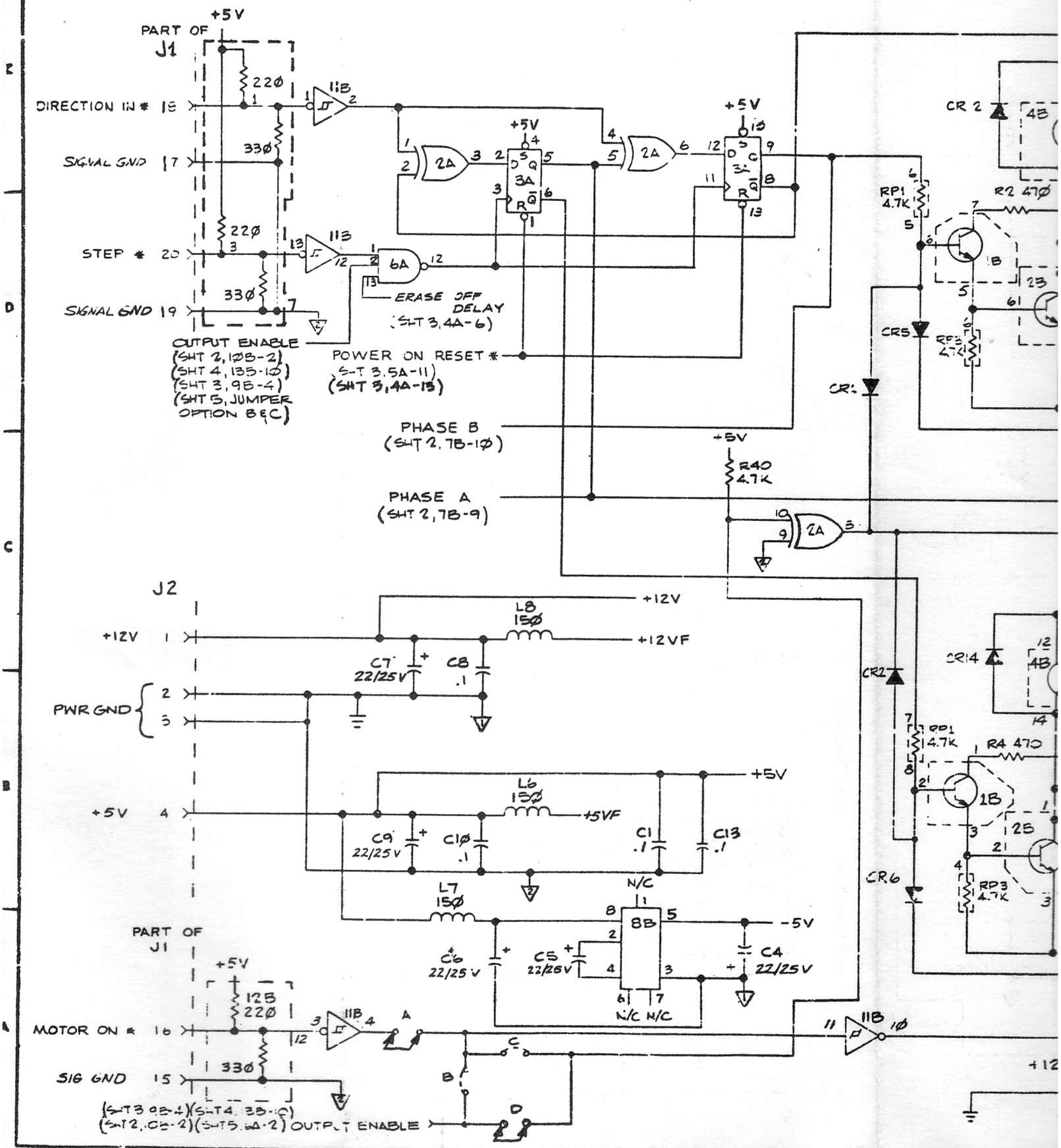
Figure 8-2. Schematic Control Board, 114761-001
112670-122B Sheet 3 of 5 8-9/8-10


+12VF
TP8
C19
22/25V
L5
33Ø
L3
82
TP6
R32
1Ø
C25
.1
HEAD
OUTPUT (A)
(SHT 3, 7D-2)
R33
8.2K
C17
C14
510pF
±5%
R25
866
±2%
50
HEAD
OUTPUT (B)
(SHT 3. 7D-15)
TP7
C18
22/25V
L4
33Ø
L2
82
TP5
C24
.1 ±10%
C16
1ØØØ pF
±5%
R23
47Ø
L1
33
R24 50K 1/2W
CW
R27
1ØK
HEAD SHIELD
(SHT 3, J6-3)



SYM	ECO	EFFECT	REVISIONS	BY	DATE	APPR'D
			SEE SH. ONE			

Figure 8-2. Schematic Control Board, 114761-001
112670-122B Sheet 4 of 5 8-11/8-12


PART OF J1
+5V
220
330
DIRECTION IN * 18
SIGNAL GND 17
STEP * 20
SIGNAL GND 19
11B
2A
3A
6A
ERASE OFF DELAY
(SHT 3, 4A-6)
OUTPUT ENABLE
(SHT 2, 10B-2)
(SHT 4, 13B-10)
(SHT 3, 9B-4)
(SHT 5, JUMPER OPTION B&C)
POWER ON RESET *
(S-T 3.5A-11)
(SHT 3, 4A-13)
PHASE B
(SHT 2, 7B-10)
PHASE A
(SHT 2, 7B-9)
R40 4.7K
CR 2
4B
RP1 4.7K
R2 470
2B
CR5
RP3 4.7K
CR1
J2
+12V 1
PWR GND 2
3
L8 15Ø
+12VF
C7 22/25V
C8 .1
L6 15Ø
+5VF
+5V 4
C9 22/25V
C10 .1
C1 .1
C13 .1
L7 15Ø
N/C
8B
-5V
C6 22/25V
C5 22/25V
C4 22/25V
N/C N/C
CR14
12
14
CR2
CR6
R4 470
1B
1
25
RP3 4.7K
PART OF J1
+5V
12B
220
330
MOTOR ON * 16
SIG GND 15
11B
A
B
C
D
(SHT 3 9B-4)(SHT 4, 13B-10)
(SHT 2, 10B-2)(SHT 5, 6A-2) OUTPUT ENABLE
+12

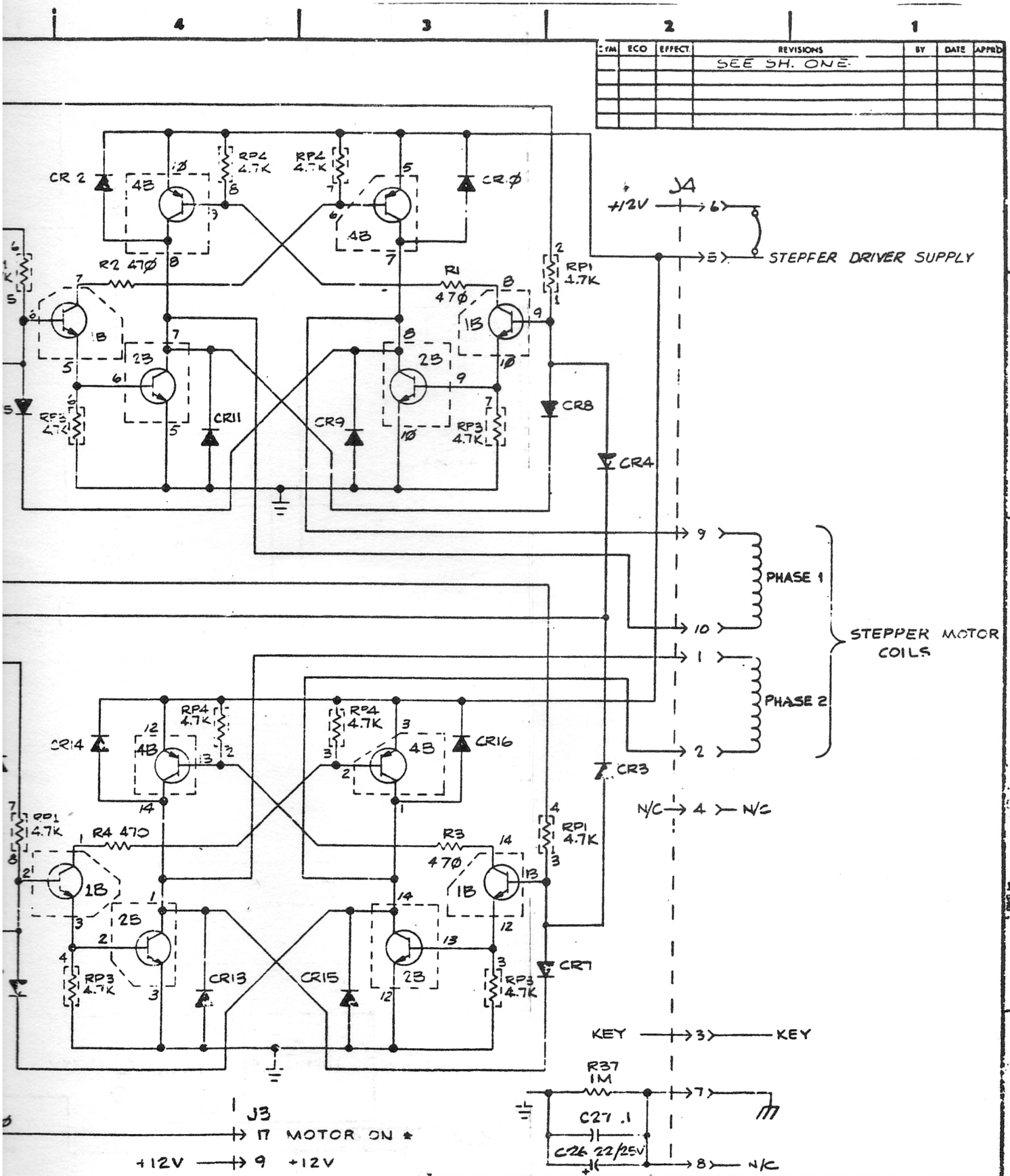
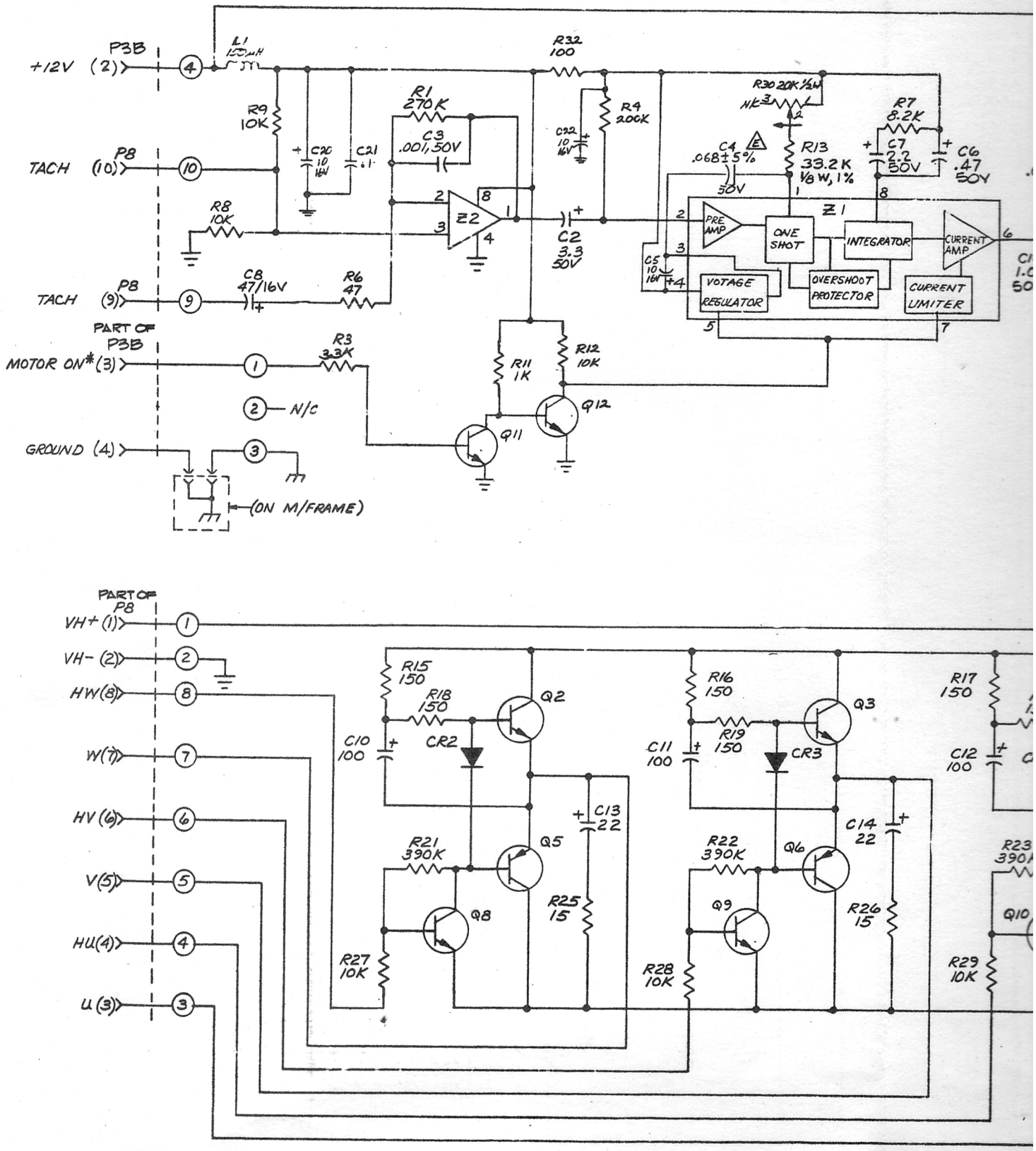
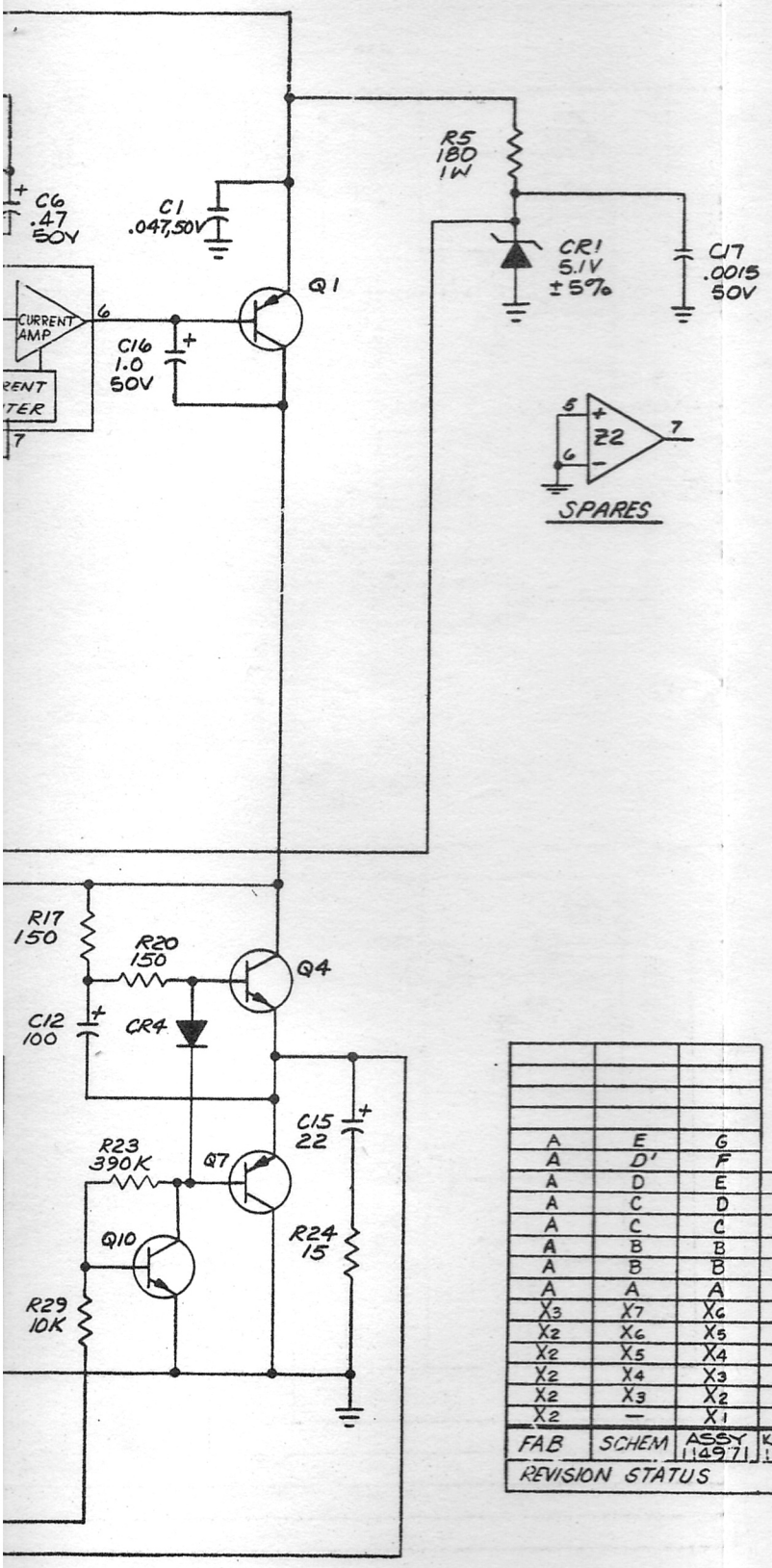


Figure 8-2. Schematic Control Board, 114761-001
112670-122B Sheet 5 of 5 8-13/8-14


+12V (2) P3B
TACH (10) P8
TACH (9) P8
MOTOR ON* (3) PART OF P3B
GROUND (4)
N/C
(ON M/FRAME)
L1 150µH
R9 10K
R8 10K
C20 10 16V
C21 .1
R1 270K
C3 .001, 50V
Z2
C8 47/16V
R6 47
R3 3.3K
R32 100
R4 200K
C22 10 16V
C2 3.3 50V
R30 20K ½W
R13 33.2K 1/8W, 1%
C4 .068 ± 5% 50V
R7 8.2K
C7 2.2 50V
C6 .47 50V
Z1
PRE AMP
ONE SHOT
INTEGRATOR
CURRENT AMP
VOLTAGE REGULATOR
OVERSHOOT PROTECTOR
CURRENT LIMITER
C5 10 16V
R11 1K
R12 10K
Q11
Q12
VH+ (1) PART OF P8
VH- (2)
HW (8)
W (7)
HV (6)
V (5)
HU (4)
U (3)
R15 150
R18 150
Q2
C10 100
CR2
R16 150
Q3
R19 150
C11 100
CR3
R17 150
C12 100
C13 22
C14 22
R21 390K
Q5
R22 390K
Q6
R23 390K
Q10
R25 15
R26 15
Q8
Q9
R27 10K
R28 10K
R29 10K



SYM	ECO	EFFECT.	REVISIONS	BY	DATE	APPRD
X3	20128	[illegible]	PILOT RELEASE - SEE ECO	[illegible]	10.20.81	[illegible]
X4	[illegible]	[illegible]	NOTE 7, F.C.O. [illegible] C6, C7	[illegible]	11.24.81	[illegible]
X5	20244	12.23.81	REVISED CIRCUIT BETWEEN Z1 AND F3B PIN 1	D.G.M.	12.23.81	[illegible]
X6	20537		C17 IS .0015 μF, 25V, 20% - WAS UNUSED PER G/N	D.G.M.		
X7	20629	[illegible]	SEE ECO	D.G.M.	1/18/82	[illegible]
A	20838	2.11.82	R13 WAS 36K, R30 WAS 10K	D.G.M.	2.11.82	[illegible]
B	20951	4.2.82	R3 WAS 1K	D.G.M.	4.2.82	[illegible]
C	20511	5.18.82	SEE ECO	S.E.O.	5.18.82	[illegible]
D	20609	7.9.82	VALUE OF R13 WAS 33 K	S.E.O.	7.9.82	[illegible]
D'	R/C	8.7.82	UPDATED REV. STATUS	S.E.O.	8.7.82	[illegible]
E	20718	9.16.82	C4: TOL 15 ± 5% WAS ± 10%	S.E.O.	9.16.82	[illegible]

NOTES: UNLESS OTHERWISE SPECIFIED

1. RESISTOR VALUES ARE IN OHMS, ± 5%, 1/4 WATT.
2. CAPACITOR VALUES ARE IN MICROFARADS, ± 20%, 25V.
3. CR1 IS 1N751A ZENER DIODE.
4. CR2,3 & 4 ARE 1N4148.
5. Z1 IS M51970L 8 PIN SIP.
6. Z2 IS LM358 8 PIN DIP.
7. Q1 IS MJE210.
8. Q2,Q3 & Q4 ARE 2N6714.
9. Q5,Q6 & Q7 ARE 2N6727.
10. Q8,9,10,11,&12 ARE 2N4401.
11. REF SYSTEM SCHEMATIC 114794-001.
12. REF NEXT ASSY 114971-001
13. KIT OF PARTS, 114979-001, IS OBSOLETE.

A	E	G	
A	D'	F	
A	D	E	—
A	C	D	—
A	C	C	D [13]
A	B	B	C
A	B	B	B
A	A	A	A
X3	X7	X6	X6
X2	X6	X5	X5
X2	X5	X4	X4
X2	X4	X3	X3
X2	X3	X2	X2
X2	—	X1	—
FAB	SCHEM	ASSY 114971	KIT PARTS 114979
REVISION STATUS			

DESCRIPTION	LAST REF DES. USED	REF DES NOT USED
RESISTOR	R32	R2,10,14,31
CAPACITOR	C22	C9,18,19
DIODE	CR4	
TRANSISTOR	Q12	
I.C.	Z2	
CHOKE	L1	

DWG No. 114972-001 REV. E

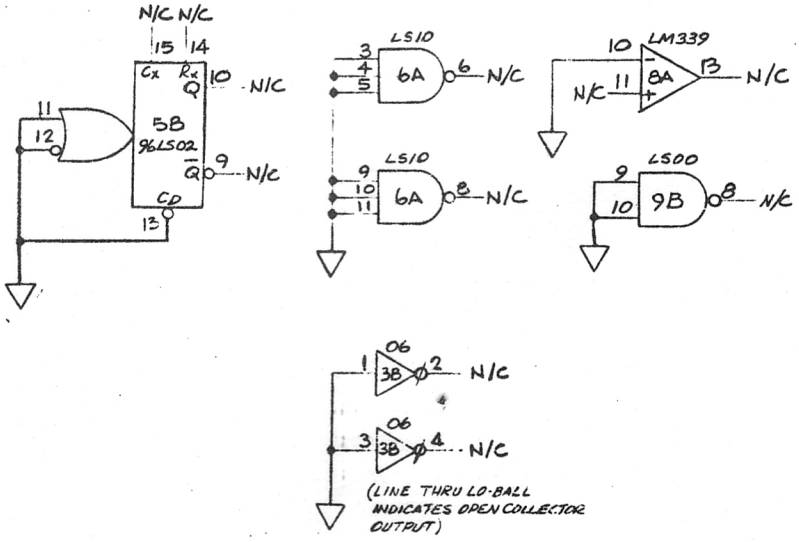
Figure 8-3. Schematic, Motor Drive Card, 114971-001
112670-122C 8-15/8-16

SIGNAL INDEX

SIGNAL	DESCRIPTION	SOURCE	ADDRESS
ERASE OFF DELAY		3B6	5D7
HEAD OUTPUT A		3B2	4D8
HEAD OUTPUT B		3B2	4C8
HEAD SHIELD		3D4	4A5
OUTPUT ENABLE		2D4	3B8,4C3,5A7,5D7
PHASE A		5C7	2B3
PHASE B		5D7	2A3
POWER ON RESET*		3A6	2D3,3D8, 5D7
SIDE SELECT*		2E6	3C8
WRITE CONT. *		2A2	3A6
WRITE DATA		2D6	3D8
WRITE GATE		2D6	3B8

DESCRIPTION	LAST REF DES. USED	REF. DES. NOT USED
I.C.	13B	
CHOKE	L8	
CONNECTOR	J6	
RESISTOR PAK	RP9	RP1
DIODE	CR26	
CAPACITOR	C35	C1,20,31 THRU 34
RESISTOR	R46	R26,29,32
L.E.D	DS1	
TRANSISTOR	Q11	
TEST POINT	TP9	
ZENER DIODE	VR1	

SPARES



REVISION STATUS		
FAB.	SCHEM	ASSY
A	A	A
A	A	B
A	B	C
A	C	D
A	D	E
A	D	F
A	D'	G
A	E	H
A	F	H
A	G	J

REVISIONS					
				BY	DATE
A	2360	PRODUCTION RELEASE		DGM	
B		PER ECO [illegible]		DGM	
C	[illegible]	SEE ECO		DGM	
D	5710	UPDATED REV. STATUS		SEO	
E	[illegible]	#2: VALUE OF C29 WAS 1 ± 10%		SEO	
F	6075	SEE ECO		SEO	
G	50425	SEE ECO		SEO	

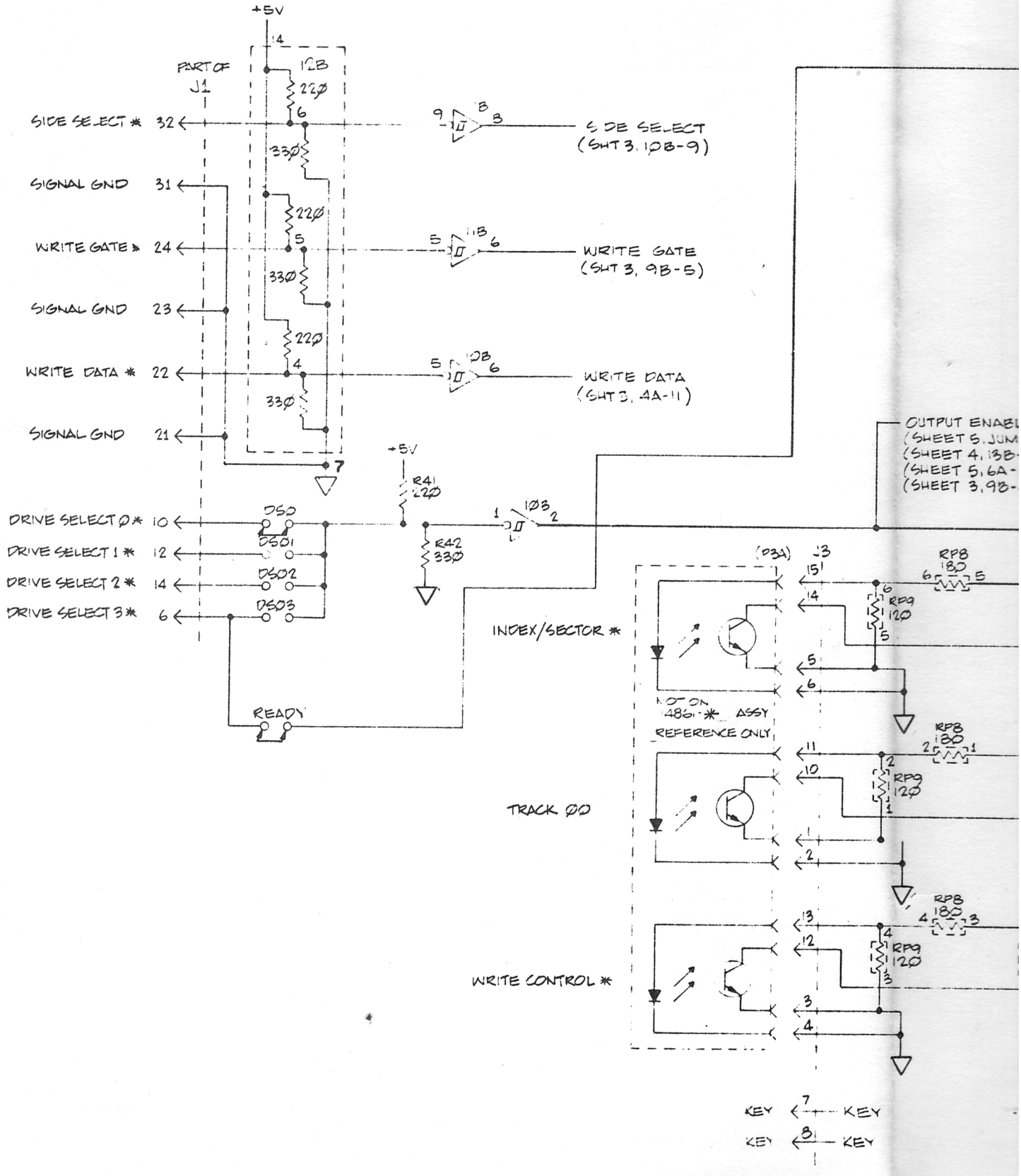
NOTES: UNLESS OTHERWISE SPECIFIED:

1. THE THREE CHARACTER SOURCE/ADDRESS IS AS FOLLOWS: SHEET Nº, VERTICAL ZONE AND HORIZONTAL ZONE.
2. RESISTOR VALUES ARE IN OHMS, ± 5%, 1/4 WATT.
3. CAPACITOR VALUES ARE IN MICROFARADS, +80%, -20%, 50V.
4. RP3 IS 701900-037 (RESISTOR PAK - 2.2K).
5. RP4 IS 701900-036 (RESISTOR PAK - 390Ω).
6. 12B IS 701900-011 (RESISTOR PAK - 220/330Ω).
7. RP2 IS 701900-029 (RESISTOR PAK - 4.7K).
8. RP5, RP6 ARE 701900-005 (RESISTOR PAK-1K).
9. RP7 IS 701900-032 (RESISTOR PAK - 22K).
10. RP8 IS 701900-033 (RESISTOR PAK - 180Ω).
11. RP9 IS 701900-034 (RESISTOR PAK - 120Ω).
12. 7A IS 701900-031 (RESISTOR PAK - 47K).
13. 7C IS 704202-113 (TRANSISTOR PAK, PNP, Q2T2905).
14. 2B IS 704900-110 (UHP407).
15. 9B IS 704620-000 (74LS00).
16. 11B IS 704620-014 (74LS14).
17. 7B IS 704620-027 (74LS27).
18. 4C IS 704600-151 (7426)
19. 3C, 13B ARE 704620-038 (74LS38)
20. 3A, 4A, ARE 704620-074 (74LS74).
21. 2A IS 704620-086 (74LS86).
22. 5A, 5B IS 704621-004 (96LS02).
23. 8A IS 704520-156 (LM339).
24. 7D IS 704810-147 (DG211).
25. 5D IS 704810-148 (MC3470).
26. 8B IS 704810-150 (ICL7660).
27. 6A IS 704620-010 (74LS10).
28. 3B IS 704600-111 (7406).
29. C17 AND C20 ARE OMITTED
30. 10B IS 704600-150 (7414)
31. Q1, Q2 AND Q7 ARE 704203-114 (TRANSISTOR-NPN-2N4401).
32. Q3 THRU Q6 ARE 704202-108 (TRANSISTOR-PNP 2N4403).
33. Q8 THRU Q11 ARE 704202-114 (TRANSISTOR-FET-2N6726).
34. INDUCTOR VALUES ARE IN MICROHENRIES ±5%.

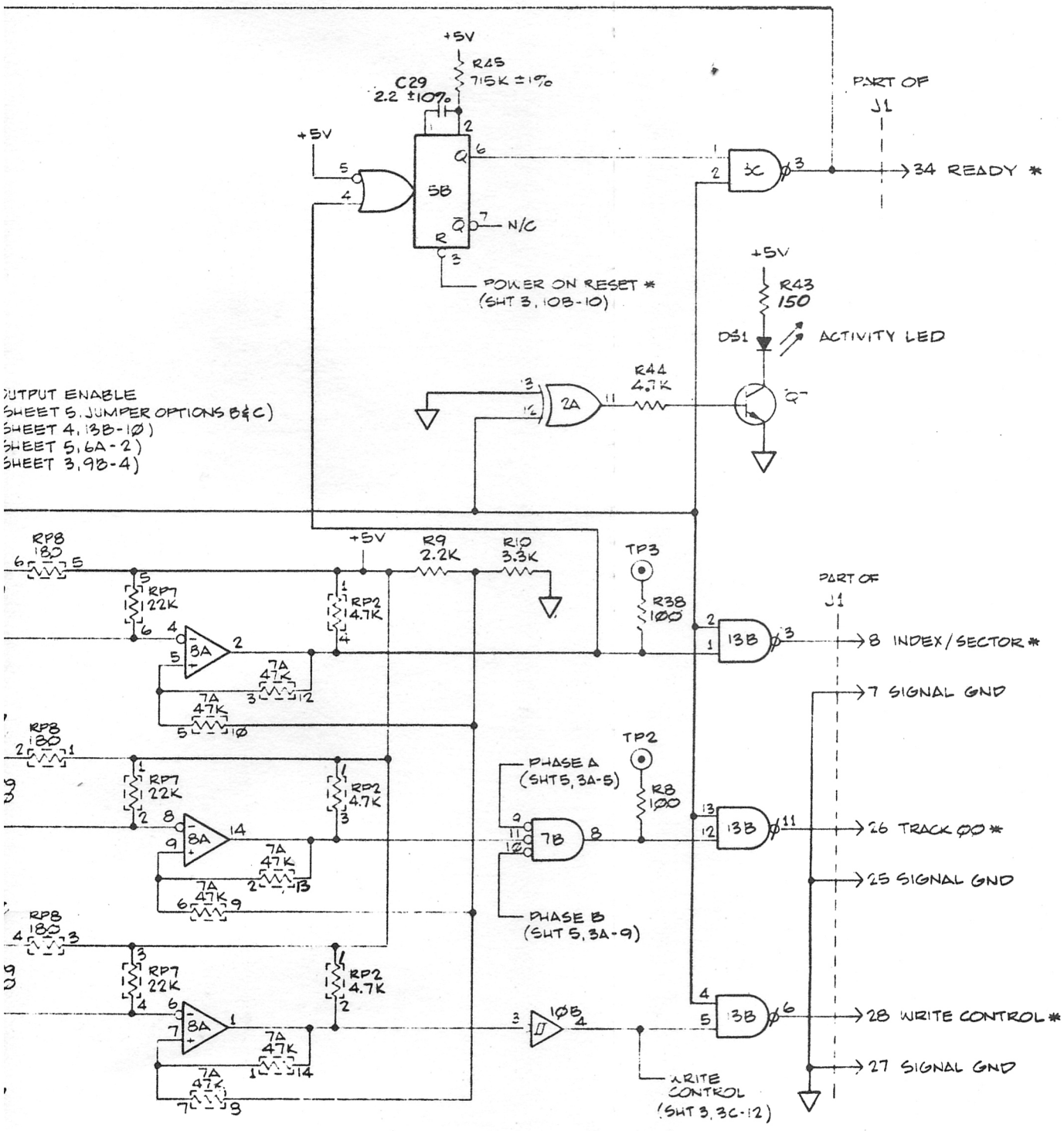
	POWER/GROUND PIN ASSIGNMENTS					
NOTE Nº	-5V	+5V	+5VF	+12V	-12VF	▽
14.				8		
15		14				7
16		14				7
17		14				7
18		14				7
19		14				7
20		14				7
21		14				7
22		16				8
23		3				12
24	4		12		13	5
25						5
26	5	8				3
27		14				7
28		14				7
30		14				7

PICO	114861-[illegible]
[illegible]	[illegible]

Figure 8-4. Schematic, Control Card 114861-001.
112670-122D Sheet 1 of 5 8-17/8-18

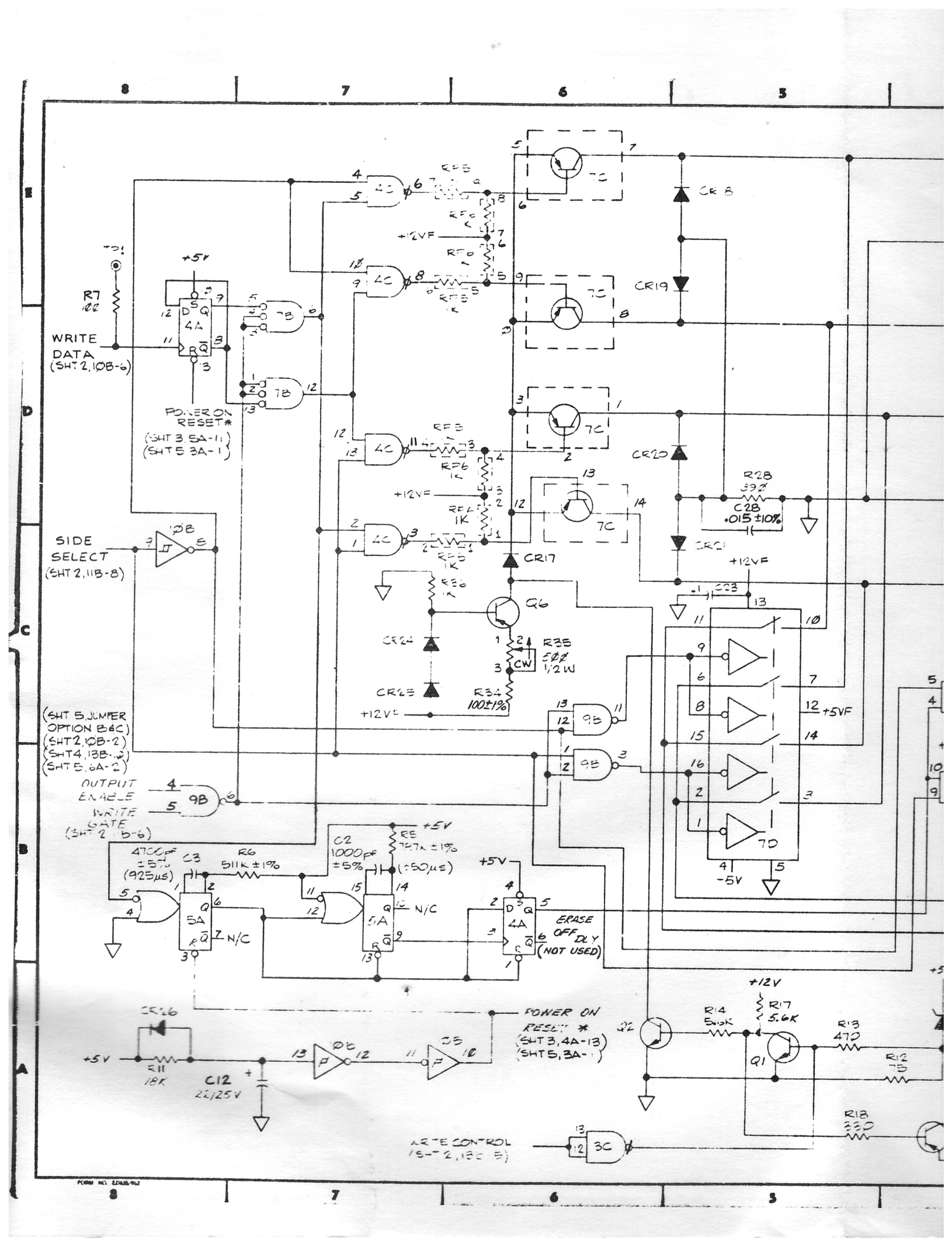

+5V
PART OF J1
SIDE SELECT * 32
SIGNAL GND 31
WRITE GATE * 24
SIGNAL GND 23
WRITE DATA * 22
SIGNAL GND 21
220
330
SIDE SELECT (SHT 3, 10B-9)
WRITE GATE (SHT 3, 9B-5)
WRITE DATA (SHT 3, 4A-11)
R41 220
R42 330
DRIVE SELECT Ø * 10
DRIVE SELECT 1 * 12
DRIVE SELECT 2 * 14
DRIVE SELECT 3 * 6
DSØ
DS1
DS2
DS3
READY
INDEX/SECTOR *
TRACK ØØ
WRITE CONTROL *
NOT ON 486-* ASSY
REFERENCE ONLY
RP8 180
RP9 120
KEY
OUTPUT ENABL
(SHEET 5, JUM
(SHEET 4, 13B-
(SHEET 5, 6A-
(SHEET 3, 9B-

SYM	ECO	EFFECT	REVISIONS	BY	DATE	APPD
			SEE SHEET 1			



114862-001 G

Figure 8-4. Schematic, Control Card 114861-001.
112670-122D Sheet 2 of 5 8-19/8-20


WRITE DATA (SHT 2, 10B-6)
R7 100
+5V
POWER ON RESET* (SHT 3, 5A-1) (SHT 5 3A-1)
SIDE SELECT (SHT 2, 11B-8)
(SHT 5 JUMPER OPTION B&C) (SHT 2, 10B-2) (SHT 4, 13B-2) (SHT 5, 6A-2)
OUTPUT ENABLE
WRITE GATE (SHT 2 5-6)
RF5
RF6 1K
RF7 1K
RF8 1K
RF9 1K
+12VF
CR8
CR19
CR20
CR21
CR17
CR24
CR25
R28 39Ø
C28 .015 ±10%
R35 50Ø 1/2W CW
R34 100±1%
Q6
C23 .1
+12VF
+5VF
-5V
4700pF ±5% (925µs) C3
R6 511K ±1%
C2 1000pF ±5%
RE 787K ±1% (750µs)
+5V
N/C
ERASE OFF DLY (NOT USED)
CR26
R11 18K
C12 22/25V
POWER ON RESET* (SHT 3, 4A-13) (SHT 5, 3A-1)
+12V
R14 5.6K
R17 5.6K
R13 470
R12 75
Q1
Q2
R18 330
WRITE CONTROL (SHT 2, 13C-5)

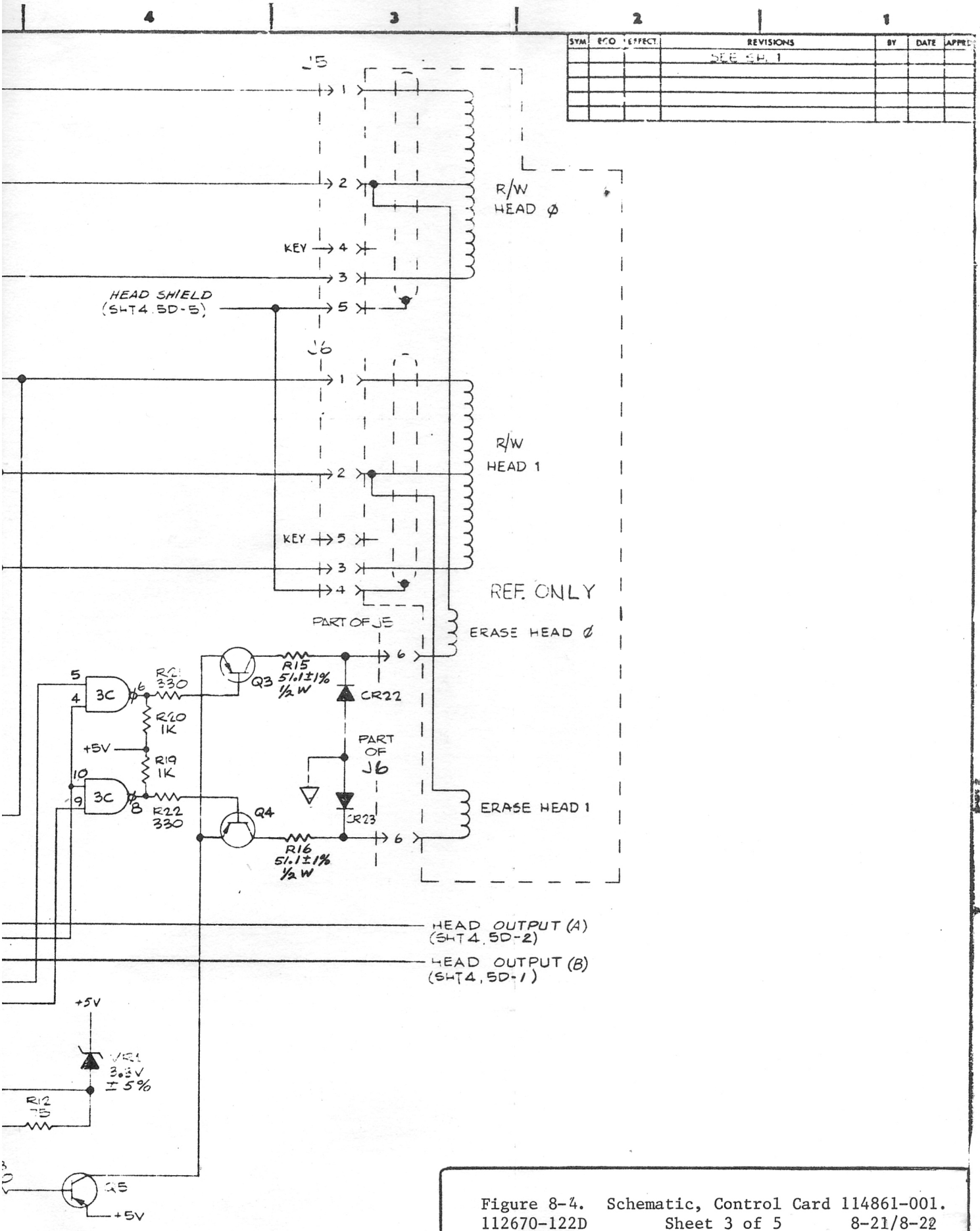
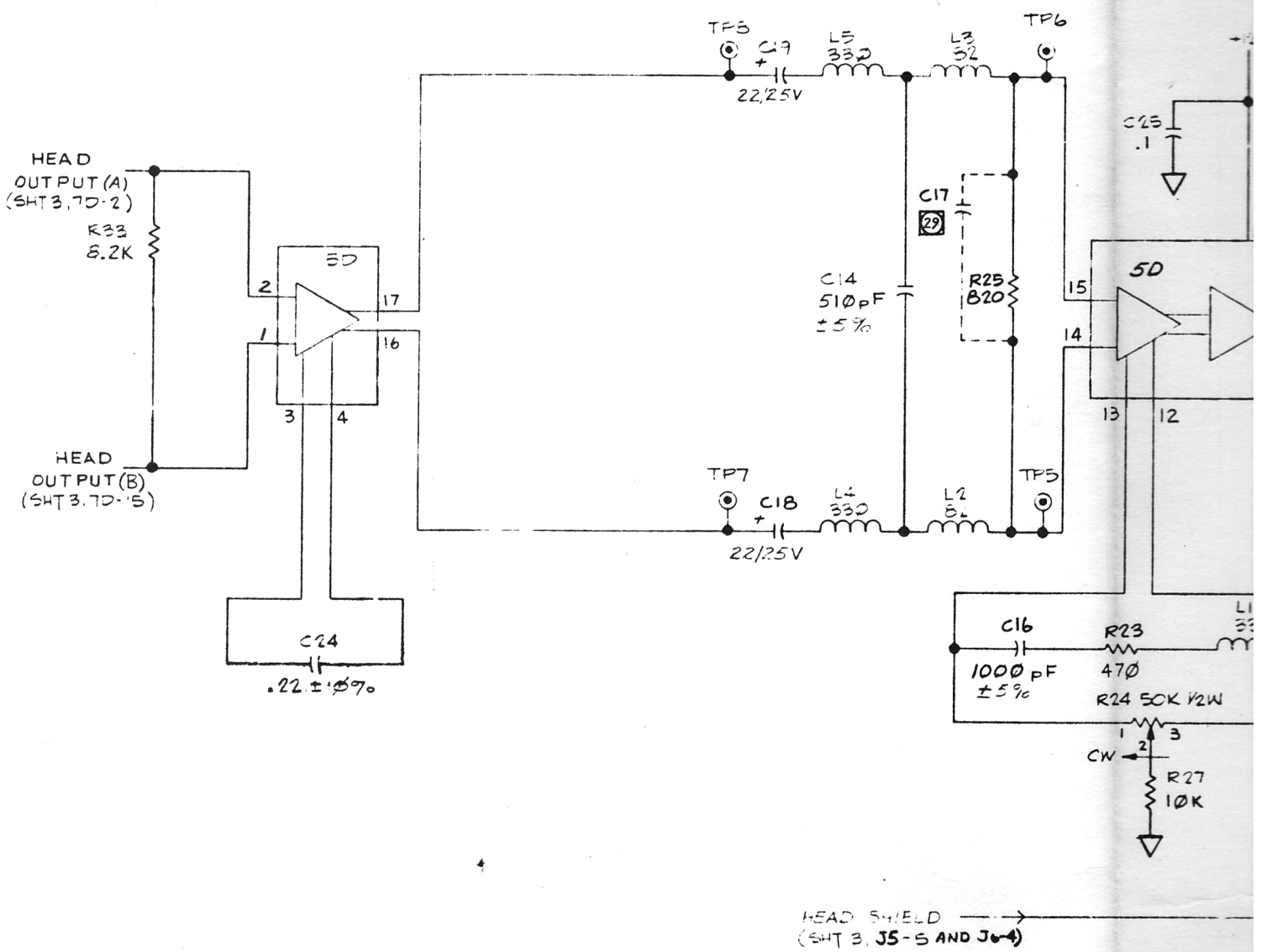


Figure 8-4. Schematic, Control Card 114861-001.
112670-122D Sheet 3 of 5 8-21/8-22


TP3
C19
+
22/25V
L5
33Ø
L3
52
TP6
C25
.1
HEAD
OUTPUT (A)
(SHT 3, 7D-2)
R33
8.2K
ED
2
1
17
16
3
4
C17
29
C14
510pF
±5%
R25
B20
50
15
14
13
12
HEAD
OUTPUT (B)
(SHT 3, 7D-5)
TP7
C18
+
22/25V
L4
33Ø
L2
52
TP5
C24
.22 ±10%
C16
1000 pF
±5%
R23
47Ø
R24 50K 1/2W
1
2
3
CW
R27
10K
HEAD SHIELD
(SHT 3, J5-5 AND J6-4)

SYM	ECO	EFFECT.	REVISIONS	BY	DATE	APPR.
			SEE SH. ONE			

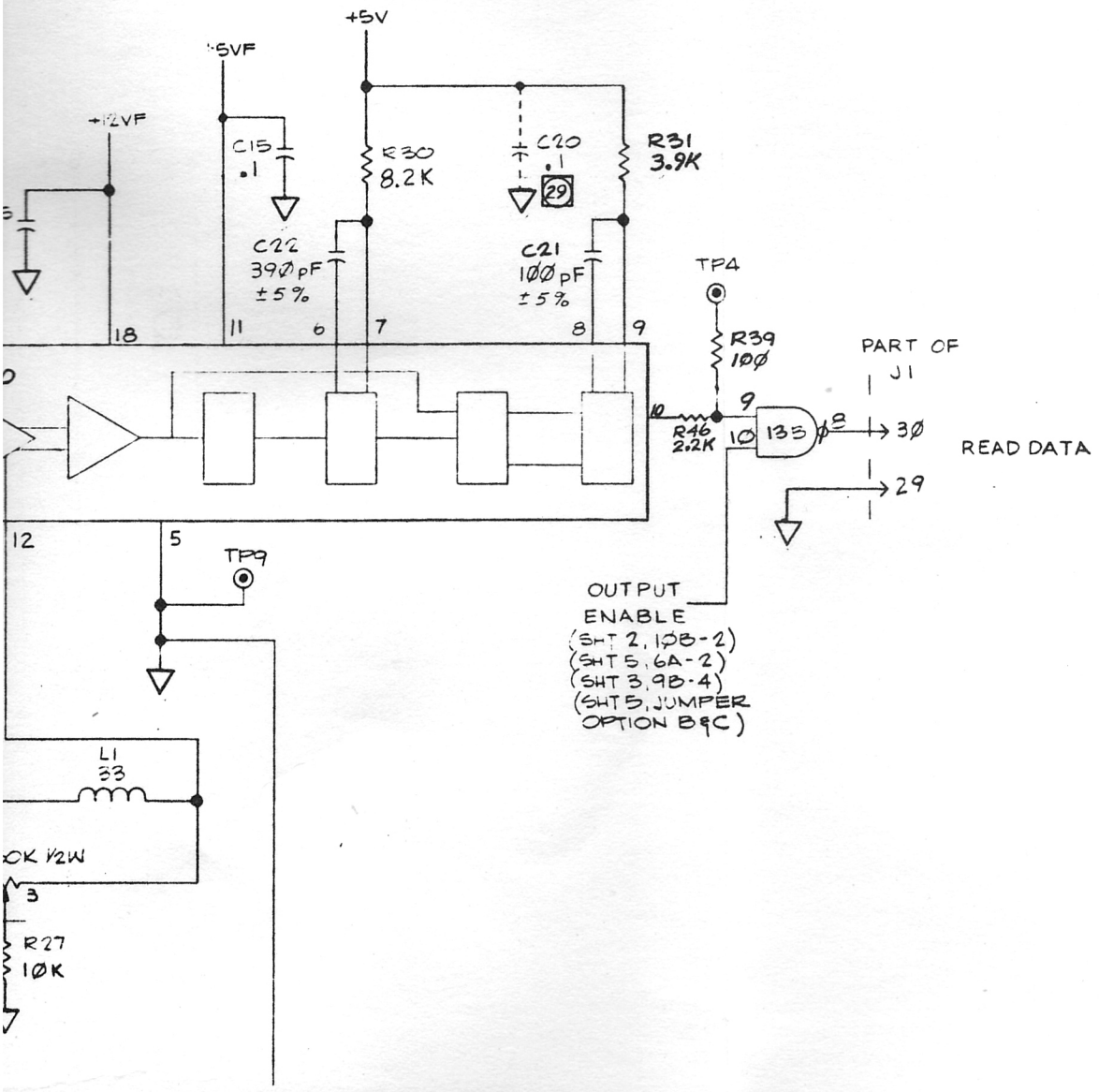
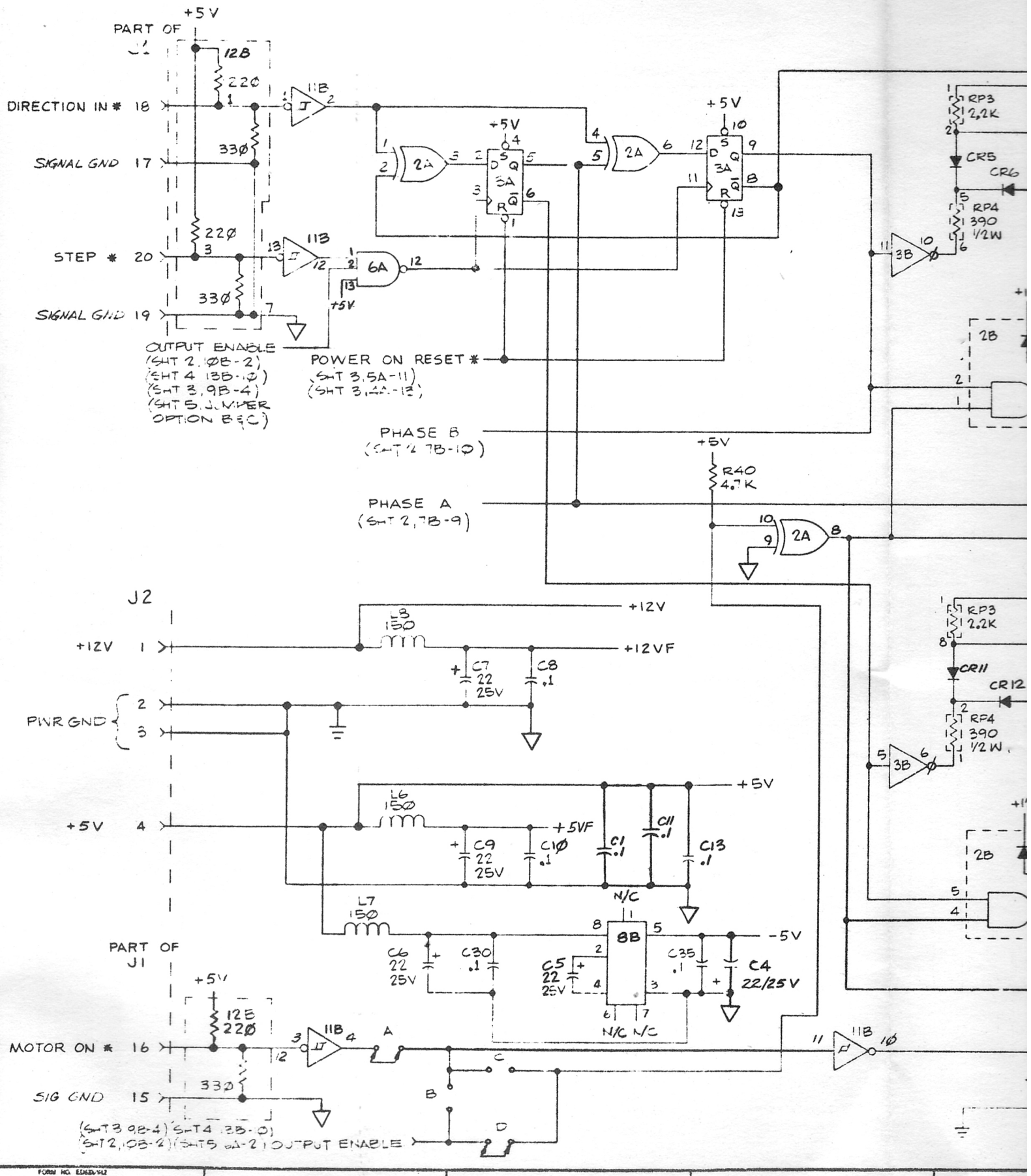


Figure 8-4. Schematic, Control Card 114861-001.
112670-122D Sheet 4 of 5 8-23/8-24

114862-001 G



FORM NO. ED6D/542

SYM	ECO	EFFECT.	REVISIONS	BY	DATE	APPR.
			SEE SH. ONE			

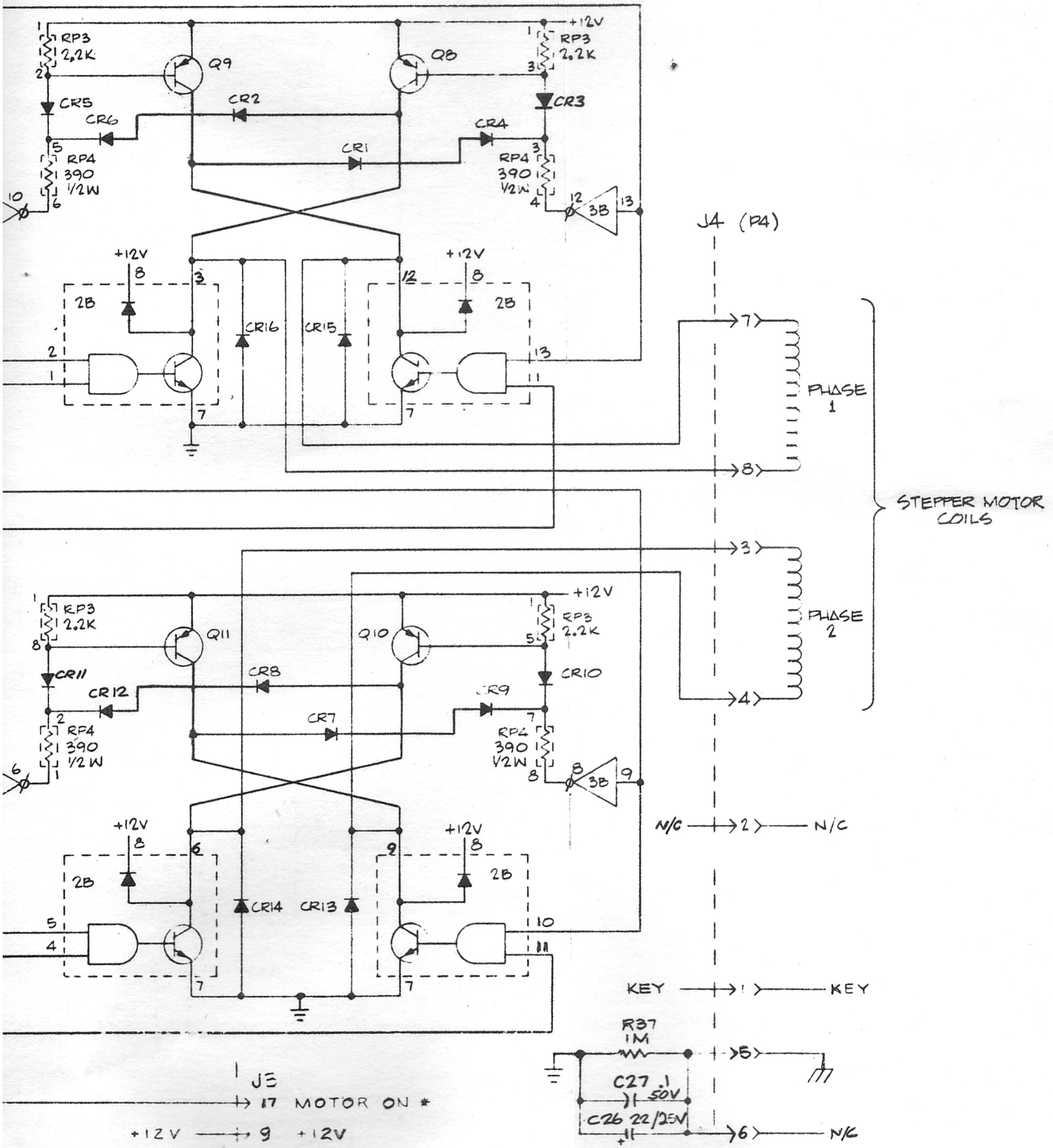


Figure 8-4. Schematic, Control Card 114861-001.
112670-122D Sheet 5 of 5 8-25/8-26

114862-001 G

Ex-Cell-O Corporation

REMEX DIVISION